UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to:
2003/01568 (ESA)
2004/00087 (EFH)

February 23, 2004

Randall F. Smith
Director, Water Division
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

Re: Biological Opinion on EPA's Proposed Approval of Revised Oregon Water Quality Standards for Temperature, Intergravel Dissolved Oxygen, and Antidegradation Implementation Methods

Dear Mr. Smith:

Enclosed is a biological opinion (Opinion) prepared by NOAA's National Marine Fisheries Service (NOAA Fisheries) pursuant to section 7 of the Endangered Species Act (ESA) on the effects of the proposed approval by the U.S. Environmental Protection Agency (EPA) of revised Oregon water quality standards for temperature, intergravel dissolved oxygen, and antidegradation implementation methods.

Species addressed by this Opinion include Upper Columbia River spring, Snake River spring/summer and fall, Upper Willamette River, and Lower Columbia River chinook salmon; Oregon Coast and Southern Oregon/Northern California coasts coho salmon; Columbia River chum salmon; Snake River Basin, Middle and Lower Columbia River, Upper Columbia River, and Upper Willamette River steelhead; and Snake River sockeye salmon.

In this Opinion, NOAA Fisheries concludes that the proposed action is not likely to jeopardize the continued existence of the 14 species of ESA-listed salmonid fishes, or destroy or adversely modify the designated critical habitat of Snake River sockeye salmon, Snake River spring/summer chinook salmon, Snake River steelhead, or and Southern Oregon/Northern California coasts coho salmon.

This document also serves as consultation on essential fish habitat pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and implementing regulations (50 CFR Part 600). NOAA Fisheries concluded that the proposed action may adversely affect designated EFH for Pacific salmon and groundfish species. As described in the enclosed consultation, 305(b)(4)(B) of the MSA requires that a Federal action agency must provide a detailed response in writing within 30 days after receiving an EFH conservation recommendation.

NOAA Fisheries acknowledges and appreciates the coordination between EPA, the U.S. Fish and Wildlife Service, the Oregon Department of Environmental Quality, and the Oregon Department of Fish and Wildlife during the development and review of the revised standards, and look forward to future cooperative efforts among these agencies. Please direct any questions regarding this consultation to Jeffrey Lockwood or Robert Anderson of my staff in the Oregon State Habitat Office at 503.231.2249 or 503.231.2226, respectively.

Sincerely,

for Michael R Crouse

D. Robert Lohn
Regional Administrator

Endangered Species Act - Section 7 Consultation
Biological Opinion

&

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat Consultation

EPA's Approval of Revised Oregon Water Quality Standards for Temperature, Intergravel Dissolved Oxygen, and Antidegradation Implementation Methods

Agency: U.S. Environmental Protection Agency

Consultation Conducted By: National Marine Fisheries Service, Northwest Region

Date Issued: February 23, 2004

Issued by: For Michael R Crouse
____
D. Robert Lohn
Regional Administrator

Refer to: **2003/01568 (ESA)**
2004/00087 (EFH)

TABLE OF CONTENTS

APPENDIX

1. INTRODUCTION

The Endangered Species Act (ESA) of 1973 (16 USC 1531-1544), as amended, establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (NOAA Fisheries), as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitats. This biological opinion (Opinion) is the product of an interagency consultation pursuant to section 7(a)(2) of the ESA and implementing regulations found at 50 Code of Federal Regulations (CFR) Part 402.

The analysis also fulfills the essential fish habitat (EFH) requirements under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)).

The proposed action is the proposed approval by the U.S. Environmental Protection Agency (EPA) of revised Oregon water quality standards for temperature, intergravel dissolved oxygen, and antidegradation implementation methods. The administrative record for this consultation is on file at the Oregon State Habitat Office of NOAA Fisheries.

1.1 Background and Consultation History

The Oregon Department of Environmental Quality (ODEQ) completed a triennial review of the state's water quality standards in January 1996 and submitted revised standards for water temperature, dissolved oxygen and hydrogen ion concentration (pH) to the U.S. Environmental Protection Agency (EPA), Region 10, for approval under the Clean Water Act (CWA) on July 11, 1996. EPA initiated consultation on Oregon's proposed water quality standards for dissolved oxygen, temperature, and pH in January, 1997. On September 18, 1998, EPA submitted a biological assessment (BA) (EPA 1998) for EPA's proposed approval of Oregon's revised water quality standards. The U.S. Fish and Wildlife Service (USFWS) NOAA Fisheries) (together referred to as 'the Services') issued biological opinions for EPA's proposed action on July 7, 1999 (NOAA Fisheries 1999a) and July 1, 1999 (USFWS 1999). The Opinions concluded that EPA's proposed approval of the Oregon water quality standards was not likely to jeopardize the continued existence of the listed, proposed, and candidate species named in the BA.

To address issues raised in the ESA consultation on its 1999 approval action, EPA proposed an intergovernmental project to develop guidance for water temperature criteria for use in the Pacific Northwest. NOAA Fisheries also required completion of this project in its July, 1999 Opinion. The goals of this project were: (1) To develop regional water temperature criteria guidance that better meet the biological requirements of listed salmonid species for survival and recovery, and can be reasonably implemented; (2) expected criteria adoption by EPA Region 10 Pacific Northwest states and Indian tribes; and (3) streamlined ESA consultations following adoption. Participating entities included Federal, state (Oregon, Washington and Idaho) and tribal partners, with an outside scientific peer review group. This effort culminated in the issuance of the EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards (Temperature Guidance) (EPA 2003). NOAA Fisheries endorsed the final document (April 23, 3002, letter from Robert Lohn, NOAA Fisheries, to John Iani, EPA Region 10), and considers the Temperature Guidance to include the best available scientific information on the thermal requirements of salmon and steelhead and on how to construct state or tribal water quality criteria for temperature.

EPA's approval and the ESA consultation with NOAA Fisheries in 1999 were challenged by Northwest Environmental Advocates, who filed a lawsuit in April, 2001, challenging the Federal agencies' decision regarding Oregon's water quality standards. On March 31, 2003, the U.S. District Court for Oregon invalidated EPA's approval of Oregon's revised standards, and directed EPA to promulgate the following Federal water quality standards for Oregon waters:

- Numeric criteria for the protection of salmonid rearing and bull trout rearing and spawning, accompanied by specific time and place use designation.
- A numeric temperature criterion for the lower Willamette River.
- A water quality criterion for intergravel dissolved oxygen (IGDO) for the protection of salmonid spawning.
- A plan for implementing the antidegradation policy adopted by Oregon.

A March 31, 2003, decision of the U.S. District Court of Oregon invalidated the Opinion issued by NOAA Fisheries on the EPA approval of new and revised Oregon water quality standards. The court ordered NOAA Fisheries to withdraw its Opinion and reinitiate consultation with the EPA under the ESA. In accordance with the stipulated compliance schedule, the Court ordered NOAA Fisheries to sign and transmit to EPA a final Opinion within 53 days of receipt of a biological evaluation (BE). The USFWS was not named in the court order.

In April 2003, EPA formed an interagency team to work on revision of the above water quality standards, and the content and structure of the BE. EPA submitted a request to the Services in July, 2003, for a list of species occurring within Oregon waters that needed to be considered for the ESA Section 7 consultation.

On December 22, 2003, NOAA Fisheries received a draft BE describing the proposed action and potential effects that may result from EPA's proposed approval of Oregon's revised water quality standards for temperature, intergravel dissolved oxygen, and antidegradation implementation methods. On January 12, 2003, NOAA Fisheries received a letter requesting informal and formal consultation pursuant to section 7(a)(2) on the draft BE. On February 2, 2004, NOAA Fisheries received an EFH assessment and request for consultation on the subject action under section 305(b) of the MSA. NOAA Fisheries received a final version of EPA's BE on February 4, 2004.

1.2 Proposed Action

1.2.1 Overview of Water Quality Standards

A water quality standard defines the water quality goals for a waterbody by designating the use or uses to be made of the water, by setting criteria necessary to protect the uses, and by preventing or limiting degradation of water quality through antidegradation provisions. The Clean Water Act (CWA) provides the statutory basis for the water quality standards program and defines broad water quality goals. For example, section 101(a) states, in part, that wherever attainable, waters achieve a level of quality that provides for the protection and propagation of fish, shellfish, and wildlife, and for recreation in and on the water.

Section 303(c) of the CWA requires that all states adopt water quality standards and that EPA review and approve these standards. In addition to adopting water quality standards, states are required to review and revise standards every 3 years. This public process, commonly referred to as the triennial review, allows for new technical and scientific data to be incorporated into the standards. The regulatory requirements governing water quality standards are established at 40 CFR Part 131.

The minimum requirements that must be included in the state standards are designated uses, criteria to protect the uses, and an antidegradation policy to protect existing uses, high-quality waters, and waters designated as Outstanding National Resource Waters. In addition to these elements, the regulations allow for states to adopt discretionary policies such as allowances for mixing zones and variances from water quality standards which also are subject to EPA review and approval.

All standards officially adopted by each state are submitted to EPA for review and approval or disapproval. EPA reviews the standards to determine whether the analyses performed are adequate, and evaluates whether the designated uses are appropriate and the criteria are protective of those uses. EPA makes a determination whether the standards meet the requirements of the CWA and EPA's water quality standards regulations. EPA then formally notifies the state of these results. If EPA determines that any such revised or new water quality standard is not consistent with the applicable requirements of the CWA, EPA is required to specify the disapproved portions and the changes needed to meet the requirements. The state is then given an opportunity to make appropriate changes. If the state does not adopt the required changes, EPA must promulgate Federal regulations to replace those disapproved portions.

Section 303 of the CWA requires states and authorized tribes to adopt water quality standards, including antidegradation provisions consistent with the regulations (40 CFR 131.12). Under these rules, states and authorized tribes are required to adopt antidegradation policies to provide three levels of water quality protection and identify implementation methods. The first level of protection (Tier 1) requires the maintenance and protection of existing instream water uses and the level of water quality necessary to protect those existing uses. Existing uses are "...those uses actually attained in the waterbody on or after November 28, 1975, whether or not they are included in the water quality standards" [40 CFR 131.3(e)].

The second level of protection (Tier 2) is for high quality waters, which are waters where the water quality is better than the levels necessary to support propagation of fish, shellfish, and wildlife, and recreation in and on the water. This high quality is to be maintained and protected unless, through a public process, some lowering of water quality is deemed to be necessary to accomodate important economic or social development in the area of the lowering. Activities such as new or increased discharges presumably would lower water quality and would not be permissible unless the state conducts a Tier 2 review.

The third and highest level of protection (Tier 3) is for Outstanding National Resource Waters (ONRWs). If a state or authorized tribe determines that the characteristics of a waterbody constitute an ONRW, such exceptional recreational or ecological significance, and designates a waterbody as such, then those characteristics must be maintained and protected. In addition to requiring states and authorized tribes to have an antidegradation policy, the regulations (40 CFR 131.12) require that implementation methods be identified. Such methods are not required to be contained in the state's regulation, but are subject to EPA review. EPA's regulations provide a great deal of discretion to states and authorized tribes regarding the amount of specificity required in antidegradation implementation methods. The regulations do not specify minimum elements for such methods, but do require that such methods are consistent with the intent of the antidegradation policy.

The CWA requires that antidegradation be applied only to point sources because the CWA gives EPA authority to regulate only point sources. Thus, whether antidegradation applies to nonpoint sources is solely a question of state and tribal law. Therefore, EPA's approval of Oregon's antidegradation implementation procedures applies only to point sources.

1.2.2 EPA's Proposed Approval

EPA's proposed approval covers revised portions of the following Oregon rules:

- Definitions, OAR 340-041-0002
- Antidegradation, OAR 340-041-0004
- Statewide Narrative Criteria, OAR 340-041-0007
- Intergravel Dissolved Oxygen (IGDO) subsection of Dissolved Oxygen,
- OAR 340-041-0016
- Temperature, OAR 340-041-0028
- Mixing Zones, OAR 340-041-0053
- Other Implementation of Water Quality Criteria, OAR 340-041-0061
- Basin-Specific Use Designations:
  OAR 340-041-0101(2), OAR 340-041-0120(2), OAR 340-041-0130(2), OAR 340-041-0140(2), OAR 340-041-0151(2), OAR 340-041-0160(2), OAR 340-041-0170(2), 340-041-0180(2), OAR 340-041-0190(2), OAR 340-041-0201(2), OAR 340-041-0220(2),

340-041-0250(2), OAR 340-041-0260(2), OAR 340-041-0271(2), OAR 340-041-0286(2), 340-041-0300(2), OAR 340-041-0310(2), OAR 340-041-0320(2), OAR 340-041-0330(2), 340-041-0340(2).

The content of these rules is described in the BE and is incorporated herein by reference. A complete version of Oregon's rule for water quality standards may be found at: http://www.deq.state.or.us/wq/standards/WQStdsTemp.htm

1.2.3 EPA-Proposed Conservation Measures

As part of its proposed action, EPA proposes to complete the following conservation measures (CMs).

Conservation Measure 1: Temperature Monitoring and Use Designations
EPA will set up a team consisting of representatives from EPA, NOAA Fisheries, USFWS, and ODEQ with the purpose of designing a temperature monitoring plan to validate assumptions with regard to spatial and seasonal temperature patterns associated with application of the numeric criteria and to identify waters that are colder than the criteria in selected basins with distinct populations of ESA-listed coho, steelhead, and bull trout. The team would leverage to the greatest extent possible existing state and local monitoring programs to meet the objectives of the monitoring plan. If needed, the team would seek additional funding and develop partnerships to collect temperature data that implements the plan and to the greatest extent possible simultaneously meets other monitoring objectives to maximize the usefulness of the data. The team would be assembled by December 30, 2004. The team would design a monitoring plan by March 30, 2005, with the goal of initial data collection during the summer of 2005 and complete data collection during the summer of 2006.

Conservation Measure 2: Validation Monitoring for Thermal Plume Provisions
The purpose of this conservation measure is to obtain the information needed to validate that the thermal plume provisions in the Oregon rule protect anadromous fish. There are two parts to this measure:

- To validate the thermal plume modeling associated with thermal plume provisions.
- To assess the effectiveness of the provision in the Oregon Rules related to the protection of salmonids from impacts of thermal plumes and heat loads.

During Part A of this conservation measure, EPA will work with ODEQ and the Services to identify three representative permits to be issued by ODEQ under the National Pollution Discharge Elimination System (NPDES) containing thermal plume provisions, for oversight consistent with the coordination procedures of the National Memorandum of Understanding (MOA). The three permits would be selected to represent different conditions (*e.g.*, large river system, small river system). The EPA, ODEQ, NOAA Fisheries, and USFWS collaboration on these permits would ensure adequate thermal plume provisions are incorporated in the permits, and that the permits contain monitoring requirements to validate the modeling.

During Part B of this conservation measure, EPA will work with the Services and ODEQ to design a monitoring study to validate that point source thermal discharges in accordance with the thermal plume provision in Oregon's water quality standards avoid or minimize adverse effects to salmon and steelhead. Study design work will begin within approximately 60 days of EPA's identification of the each of the three permits in Part A and will be completed within 120 days. Upon completion of the monitoring study design, EPA will seek funding from all possible sources, including private industry associations to support the monitoring study. EPA will report to NOAA Fisheries and the USFWS on the status of funding efforts within 180 days of commencing the search for funding. Should EPA secure funding, monitoring work shall begin during the next summer following funding, and EPA will provide the study results to the Services within 6 months after the monitoring is completed.

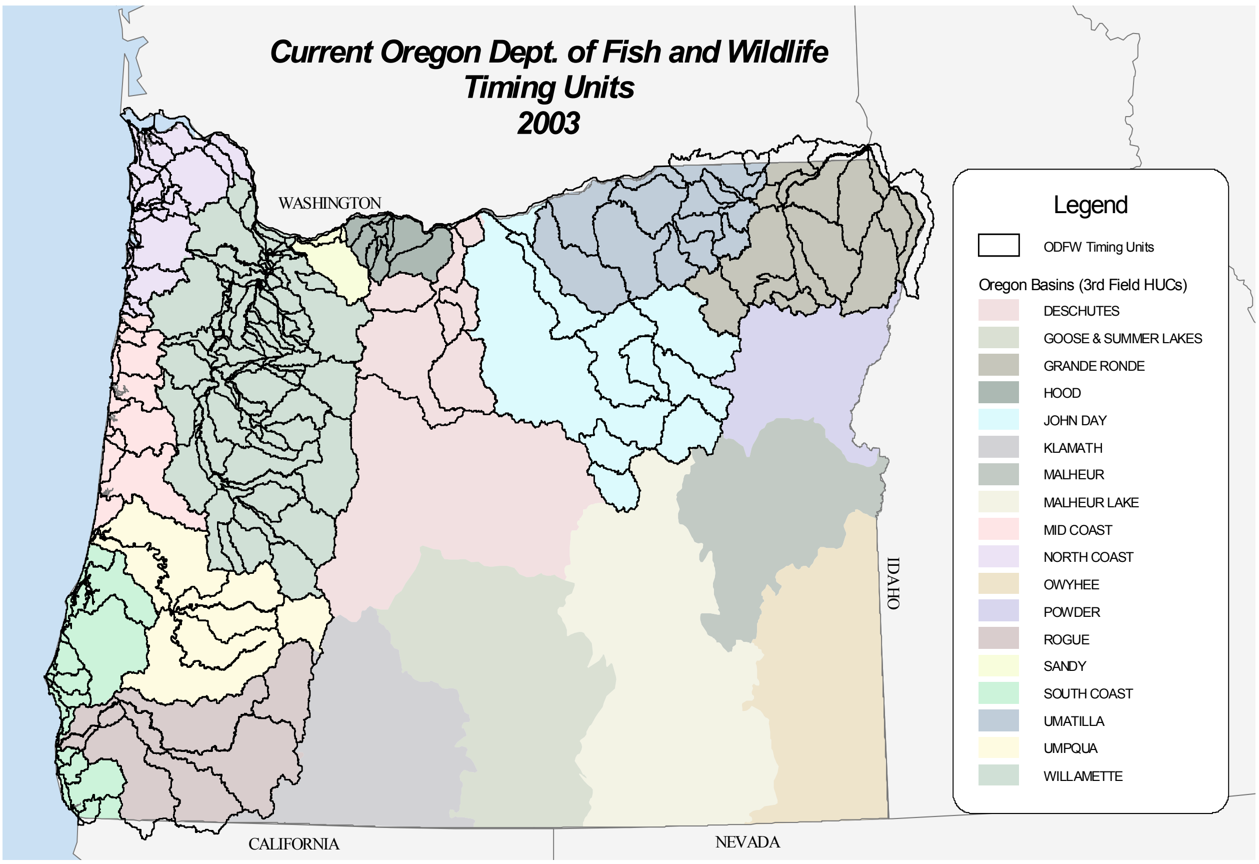
Conservation Measure 3: Two-Year Review

Within two years of the date of EPA's approval of the Oregon rules, EPA will participate with ODEQ, NOAA Fisheries, the USFWS, and interested tribes in a review of the Oregon Division 41 Rules, including consideration of: (1) Implementation of the antidegradation provisions, the natural conditions provisions, the thermal plume provisions, heat load limits, and variances; (2) identification of cold water refugia under the migration corridor criterion; (3) progress on effluent trading pilot programs; and (4) application of the requirement to ensure no adverse effects to threatened and endangered species as part of ODEQ's antidegradation implementation methods.

1.3 Description of the Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). For this consultation, NOAA Fisheries defines the action area as all basins in Oregon with anadromous fish use (Figure 1) or designated critical habitat, including the Columbia River from the mouth to the Washington-Oregon border, and the Snake River from river mile 169 to river mile 247.5.

Figure 1. Basins (5th field) in the State of Oregon with Anadromous Fishes. Basins are divided by Oregon Department of Fish and Wildlife into discrete timing units (3rd field).



2. ENDANGERED SPECIES ACT

2.1 Biological Opinion

This consultation considers the potential effects of the proposed approval by the EPA of revised Oregon water quality standards for temperature, intergravel dissolved oxygen, and antidegradation on the species listed in Table 1. The objective of this consultation is to determine whether the proposed action is likely to jeopardize the continued existence of the ESA-listed species, or destroy or adversely modify designated critical habitat for Southern Oregon/Northern California coasts coho salmon, Snake River fall chinook, Snake River spring/summer chinook salmon, or Snake River sockeye salmon. This consultation is conducted pursuant to section 7(a)(2) of the ESA and its implementing regulations (50 CFR 402). The sections of NOAA Fisheries' 1999 Opinion pertaining to EPA's approval of Oregon's revised water quality standards for water column dissolved oxygen and hydrogen ion concentration (pH) were not included in the court order, and therefore remain in effect.

2.1.1 Biological Information and Critical Habitat

Snake River (SR) Fall Chinook Salmon

The SR fall chinook salmon evolutionarily significant unit (ESU) once spawned in the mainstem of the SR from its confluence with the Columbia River upstream to Shoshone Falls (RM 615). The spawning grounds between Huntington (RM 328) and Auger Falls (RM 607) were historically the most important for this species. Only limited spawning activity occurred downstream of RM 273 (Waples *et al.* 1991a), about one mile below Oxbow Dam (Waples *et al.* 1991a). However, irrigation and hydropower projects on the mainstem SR have inundated, or blocked access to, most of this area in the past century. The construction of Swan Falls Dam (RM 458) in 1901 eliminated access to much of this habitat and the completion of Brownlee Dam in 1958 (RM 285), Oxbow Dam in 1961 (RM 272), and Hells Canyon Dam in 1967 (RM 247) blocked access to the rest.

Since 1991, spawning has been limited primarily to the mainstem SR between a point upstream of Lower Granite Reservoir (RM 149) and Hells Canyon Dam (RM 247, and the lower reaches of the Grande Ronde, Clearwater, and Tucannon rivers, tributaries to the SR. Redds in the Clearwater River have been observed from its mouth to slightly upstream of its confluence with the north fork (about 40 miles).

Table 1. Endangered and Threatened Pacific Salmon and Steelhead Under NOAA Fisheries' Jurisdiction in Oregon.

Evolutionarily Significant Unit	**Final Rule** E = Endangered T = Threatened	**Critical habitat (Final Rule)**	**Protective Regulations (Final Rule)**
Snake River fall chinook salmon	T: April 22, 1992; 57 FR 14653	December 28, 1993; 58 FR 68543	April 22, 1992; 57 FR 14653
Snake River spring/summer chinook salmon	T: April 22, 1992; 57 FR 146531	October 25, 1999; 64 FR 57399	April 22, 1992; 57 FR 14653
Snake River sockeye salmon	E: November 20, 1991; 56 FR 58619	December 28, 1993; 58 FR 68543	ESA section 9 applies
Snake River steelhead	T: August 18, 1997; 62 FR 43937	N/A	July 10, 2000; 65 FR 42422
Lower Columbia River chinook salmon	T: March 24, 1999; 64 FR 14308	N/A	July 10, 2000; 65 FR 42422
Upper Columbia River spring chinook salmon	E: March 24, 1999; 64 FR 14308	N/A	ESA section 9 applies
Upper Willamette River chinook salmon	T: March 24, 1999; 64 FR 14308	N/A	July 10, 2000; 65 FR 42422
Columbia River chum salmon	T: March 25, 1999; 64 FR 14508	N/A	July 10, 2000; 65 FR 42422
Southern Oregon/Northern California Coasts coho salmon	T: May 6, 1997; 62 FR 24588	May 5, 1999; 64 FR 24049	July 18, 1997; 62 FR 38479
Oregon Coast coho salmon	T: August 10, 1998; 63 FR 42587	N/A	July 10, 2000; 65 FR 42422
Middle Columbia River steelhead	T: March 25, 1999; 64 FR 14517	N/A	July 10, 2000; 65 FR 42422
Lower Columbia River steelhead	T: March 19, 1998; 63 FR 13347	N/A	July 10, 2000; 65 FR 42422
Upper Willamette River steelhead	T: March 25, 1999; 64 FR 14517	N/A	July 10, 2000; 65 FR 42422
Upper Columbia River steelhead	E: August 18, 1997; 62 FR 43937	N/A	ESA section 9 applies

No reliable estimates of historical abundance are available (Waples *et al.* 1991b), but because of their dependence on mainstem habitat for spawning, fall chinook have probably been affected to a greater extent by irrigation and hydroelectric projects than any other species of salmon in the SR basin. The mean number of adult SR fall chinook salmon declined from 72,000 in the 1930s and 1940s to 29,000 during the 1950s. In spite of this, the SR remained the most important natural production area for fall chinook in the Columbia River basin through the 1950s. The number of adults counted at the uppermost SR mainstem dams averaged 12,720 total spawners from 1964 to 1968; 3,416 spawners from 1969 to 1974; and 610 spawners from 1975 to 1980 (Waples, *et al.* 1991b). Most adult SR fall chinook spend three years at sea before migrating up the Columbia and Snake rivers between August and October (Waples *et al.* 1991b). Spawning occurs in the mainstem SR and in the lower parts of its major tributaries in between late October and mid-December, typically peaking in November (Myers *et al.* 1998). Fry emerge from the spawning beds from late March through early June. At present, the peak of the smolt outmigration usually occurs in July, however juvenile fall chinook may be found migrating in the lower Snake and Columbia rivers from May through October[1]. SR fall chinook typically exhibit an "ocean" type juvenile life history pattern, usually rearing in freshwater for only a few months before migrating to the ocean.

SR Spring/Summer Chinook Salmon

It is estimated that at least 1.5 million spring/summer chinook salmon returned to the SR in the late 1800s, approximately 39 to 44% of all spring/summer chinook in the Columbia River basin. Historically, Shoshone Falls (RM 615) was the uppermost limit to spring/summer chinook migration, and spawning occurred in virtually all suitable and accessible habitat in the SR basin (Fulton 1968 and Matthews and Waples 1991). The development of mainstem irrigation and hydroelectric projects in the mainstem SR basin have significantly reduced the amount of habitat available for spring/summer chinook (see discussion in 4.1.1, above) such that between 1950 and 1960, an average of 125,000 adults returned to the SR, only 8% of the historic estimate. An estimated average of 100,000 wild adults would have returned from 1964 to 1968 each year after adjusting for fish harvested in the river fisheries below McNary Dam. However, actual counts of wild adults at Ice Harbor Dam annually averaged only 59,000 each year from 1962 to 1970. The estimated number of wild adult chinook salmon passing Lower Granite Dam between 1980 and 1990 was 9,674 fish (Matthews and Waples 1991). A recent 5-year geometric mean (1992-1996) was only 3,820 naturally-produced spawners (Myers *et al.* 1998). This is less than 0.3% of the estimated historical abundance of wild SR spring/summer chinook.

[1] In its comments on the draft USBR 1999 Biological Opinion, the State of Idaho commented that "it is generally accepted that peak juvenile Snake River fall chinook migration historically coincided with the declining hydrograph following spring snowmelt" (Kempthorne 1999). However, Krzma and Raleigh (1970) observed that the migration of juvenile fall chinook into Brownlee Reservoir in 1962 and 1963 began in mid-April, and ended by mid-June (roughly 75% of the migration took place during the second and third weeks of May in those years). Juvenile fall chinook captured between mid-May and mid-June averaged 71, 81, and 79 mm in 1962, 1963, and 1964, respectively. Similarly, Mains and Smith (1964), who monitored the migration of chinook salmon in the lower Snake River (RM 82) in 1954 and 1955, collected chinook salmon fry (most likely those of fall chinook salmon) migrating in March and April, and documented that the migration of chinook salmon smolts was nearly complete by the end of June. The average length of fingerlings in June was 90.7 mm. Thus, the historic migration of fall chinook salmon through the Snake River was more likely to have occurred between late-May and late-June, nearer the peak of historical hydrograph.

SR spring/summer chinook migrate through the Columbia River from March through July, and spawn in smaller, higher elevation streams than do fall chinook. Fry generally emerge from the gravel between February and June. SR spring/summer chinook exhibit a "stream" type juvenile life history pattern, rearing for one, or sometimes even two years in freshwater before migrating to the ocean from April through June. These smolts are often referred to "yearling" chinook. Adults typically remain in the ocean for two or three years before returning to spawn (Matthews and Waples 1991).

<u>SR Sockeye Salmon</u>
Before the turn of the century (c. 1880), about 150,000 sockeye salmon ascended the Wallowa, Payette, and Salmon River basins to spawn in natural lakes (Evermann 1896). Sockeye populations in the Payette basin lakes were eliminated after a diversion dam near Horseshoe Bend was constructed in 1914, and Black Canyon Dam was completed in 1924. In 1916, a dam at Wallowa Lake was increased in height, resulting in the extinction of indigenous sockeye in Wallowa Lake. Sockeye salmon in the Salmon River occurred historically in at least four lakes within Idaho's Stanley basin: Alturas, Redfish, Pettit, and Stanley Lakes. Sunbeam Dam, 20 miles downstream from Redfish Lake, severely limited sockeye and other anadromous salmonid production in the upper Salmon River between 1910 to 1934 (Waples *et al.* 1991a). In the 1950s and 1960s, more than 4,000 adults returned annually to Redfish Lake. Between 1985 and 1987, an average of 13 sockeye were counted at the Redfish Lake weir (USBR 1998). Only 10 sockeye have returned to Redfish Lake since 1994: one in 1994, one in 1996, one in 1998 and seven in 1999 (all of those returning in 1999 were 2nd generation progeny of wild sockeye that returned to Idaho in 1993). Since 1991, adult sockeye returning to Redfish Lake have been captured to support a captive broodstock program.

Historically, SR sockeye salmon adults entered the Columbia River in June and July, migrated upstream through the Snake and Salmon Rivers, and arrived at Redfish Lake in August and September. Spawning peaks in October and occurs in lakeshore gravels. Fry emerge in late April and May and move immediately to the open waters of the lake where they feed on plankton for one to three years before migrating to the ocean. Juvenile sockeye generally leave Redfish Lake from late April through May, and migrate nearly 900 miles to the Pacific Ocean. Although pre-dam reports indicate that sockeye salmon smolts migrated in May and June, tagged sockeye smolts from Redfish Lake passed Lower Granite Dam from mid-May to mid-July. SR sockeye spend 2 to 3 years in the Pacific Ocean before returning to their natal lake to spawn.

<u>SR Steelhead</u>
Historically, SR steelhead spawned in virtually all accessible habitat in the SR up to Shoshone Falls (RM 615). The development of irrigation and hydropower projects on the mainstem SR have significantly reduced the amount of available habitat for this species (see discussion for spring/summer chinook, above). No valid historical estimates of adult steelhead returning to the SR basin before the completion of Ice Harbor Dam in 1962 are available. However, SR steelhead sportfishing catches ranged from 20,000 to 55,000 fish during the 1960s (Fulton 1970). The run of steelhead was likely several times as large as the sportfish take. Between 1949 and 1971, adult steelhead counts at Lewiston Dam (on the Clearwater River) averaged about 40,000 per year.

The count at Ice Harbor Dam in 1962 was 108,000 and averaged approximately 70,000 per year between 1963 and 1970.

A recent 5-year geometric mean (1990-1994) for escapement above Lower Granite Dam was approximately 71,000. However, the wild component of this run was only 9,400 adults (7,000 A-run and 2,400 B-run). In recent years average densities of wild juvenile steelhead have decreased significantly for both A-run and B-run steelhead. Many basins within the SR are significantly under-seeded relative to the carrying capacity of streams (Busby *et al.* 1996).

Steelhead populations exhibit both anadromous (steelhead) and freshwater resident (rainbow or red-band trout) forms. Unlike other Pacific salmon species, steelhead are capable of spawning on more than one occasion, returning to the ocean to feed between spawning events. SR steelhead rarely return to spawn a second time. Steelhead can be classified into two reproductive types: Stream-maturing steelhead, which enter fresh water in a sexually immature condition and wait several months before spawning; and ocean-maturing steelhead, which return to freshwater with fully developed gonads and spawn shortly thereafter. In the Pacific Northwest, stream-maturing steelhead enter fresh water between May and October and are referred to as "summer" steelhead. In comparison, ocean-maturing steelhead return between November and April and are considered "winter" steelhead. Inland steelhead populations in the Columbia River basin are almost exclusively of the summer variety (Busby *et al.* 1996).

SR steelhead can be further divided into two groupings: A-run steelhead and B-run steelhead. This dichotomy reflects the bimodal migration of adult steelhead observed at Bonneville Dam. A-run steelhead generally return to fresh water between June and August after spending 1 year in the ocean. These fish are typically less than 77.5 cm in length. B-run steelhead usually return to fresh water from late August to October after spending 2 years in the ocean and are generally greater than 77.5 cm in length.

Both A-run and B-run spawn the following spring from March to May in small to mid-sized streams. The fry emerge in 7 to 10 weeks, depending on temperature, and usually spend 2 or 3 years in fresh water before migrating to the ocean from April to mid-June. These estimates are based on population averages and steelhead are capable of remarkable plasticity with in their life cycles.

Lower Columbia River (LCR) Chinook Salmon

The LCR chinook salmon ESU includes all native populations from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls. The former location of Celilo Falls (inundated by The Dalles reservoir in 1960) is the eastern boundary for this ESU. Stream-type, spring-run chinook salmon found in the Klickitat River, or the introduced Carson spring-run chinook salmon strain, are not included in this ESU. Spring-run chinook salmon in the Sandy River have been influenced by spring-run chinook salmon introduced from the Willamette River ESU. However, analyses suggest that considerable genetic resources still reside in the existing population (Myers *et al.* 1998). Recent escapements above Marmot Dam on the Sandy River average 2,800 and have been increasing (ODFW 1998a).

Historical records of chinook salmon abundance are sparse, but cannery records suggest a peak run of 4.6 million fish in 1883. Although fall-run chinook salmon are still present throughout much of their historical range, most of the fish spawning today are first-generation hatchery strays. Furthermore, spring-run populations have been severely depleted throughout the ESU and extirpated from several rivers.

Apart from the relatively large and apparently healthy fall-run population in the Lewis River, production in this ESU appears to be predominantly hatchery-driven with few identifiable naturally-spawned populations. All basins are affected (to varying degrees) by habitat degradation. Hatchery programs have had a negative effect on the native ESU. Efforts to enhance chinook salmon fisheries abundance in the lower Columbia River began in the 1870s. Available evidence indicates a pervasive influence of hatchery fish on natural populations throughout this ESU, including both spring- and fall-run populations. The large number of hatchery fish in this ESU make it difficult to determine the proportion of naturally-produced fish. The loss of fitness and diversity within the ESU is an important concern. The median population growth rate over a base period from 1980 through 1998 ranged from 0.98 to 0.88, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (McClure *et al.* 2000).

Upper Columbia River (UCR) Spring Chinook Salmon

The UCR ESU includes spring-run chinook populations found in Columbia River tributaries between Rock Island and Chief Joseph Dams, notably the Wenatchee, Entiat, and Methow River Basins. The populations are genetically and ecologically separate from the summer- and fall-run populations in the lower parts of many of the same river systems (Myers *et al.* 1998). Although fish in this ESU are genetically similar to spring chinook in adjacent ESUs, they are distinguished by ecological differences in spawning and rearing habitat preferences. For example, spring-run chinook in upper Columbia River tributaries spawn at lower elevations (500 to 1,000 m) than in the Snake and John Day River systems.

The UCR populations were intermixed during the Grand Coulee Fish Maintenance Project (1939 through 1943), resulting in loss of genetic diversity between populations in the ESU. Homogenization remains an important feature of the ESU. Fish abundance has tended downward both recently and over the long term. At least six former populations from this ESU are now extinct, and nearly all extant populations have fewer than 100 wild spawners.

Given the lack of information on chinook salmon stocks that are presumed to be extinct, the relationship of these stocks to existing ESUs is uncertain. Recent total abundance within this ESU is quite low, and escapements in 1994-1996 were the lowest in at least 60 years. At least six populations of spring chinook salmon in this ESU have become extinct, and almost all remaining naturally-spawning populations have fewer than 100 spawners. Extinction risks for UCR spring chinook salmon are 50% for the Methow, 98% for the Wenatchee, and 99% for the Entiat spawning populations (Cooney 2002). In 2002, the spring chinook count at Priest Rapids Dam was 34,083 with 24,000 arriving at Rock Island Dam. The 2002 count was about 67.6% and

242% of the respective 2001 and 10-year average adult spring chinook count at Priest Rapids Dam.

Upper Willamette River (UWR) Chinook Salmon

The UWR chinook salmon ESU includes native spring-run populations above Willamette Falls and in the Clackamas River. In the past, it included sizable numbers of spawning salmon in the Santiam River, the middle fork of the Willamette River, and the McKenzie River, as well as smaller numbers in the Molalla River, Calapooia River, and Albiqua Creek. Although the total number of fish returning to the Willamette has been relatively high (24,000), about 4,000 fish now spawn naturally in the ESU, two-thirds of which originate in hatcheries. The McKenzie River supports the only remaining naturally-reproducing population in the ESU (ODFW 1998a).

There are no direct estimates of the size of the chinook salmon runs in the Willamette basin before the 1940s. The Native American fishery at the Willamette Falls may have yielded 908,000 kilograms of salmon (454,000 fish, each weighing 9.08 kg) (McKernan and Mattson 1950). Egg collections at salmon hatcheries indicate that the spring chinook salmon run in the 1920s may have been five times the run size of 55,000 fish in 1947, or 275,000 fish (Mattson 1948). Much of the early information on salmon runs in the upper Willamette River basin comes from operation reports of state and Federal hatcheries.

Fish in this ESU are distinct from those of adjacent ESUs in life history and marine distribution. The life history of chinook salmon in the UWR ESU includes traits from both ocean- and stream-type development strategies. Tag recoveries indicate that the fish travel to the marine waters off British Columbia and Alaska. More Willamette fish are, however, recovered in Alaskan waters than fish from the LCR ESU. UWR chinook salmon mature in their fourth or fifth years. Historically, 5-year-old fish dominated the spawning migration runs, however, recently most fish have matured at age 4. The timing of the spawning migration is limited by Willamette Falls. High flows in the spring allow access to the upper Willamette basin, whereas low flows in the summer and autumn prevent later-migrating fish from ascending the falls. The low flows may serve as an isolating mechanism, separating this ESU from others nearby.

While the abundance of UWR spring chinook salmon has been relatively stable over the long term and there is evidence of some natural production, at present natural production and harvest levels the natural population is not replacing itself. With natural production accounting for only one-third of the natural spawning escapement, natural spawners may not be capable of replacing themselves even in the absence of fisheries. The introduction of fall-run chinook into the basin and the laddering of Willamette Falls have increased the potential for genetic introgression between wild spring- and hatchery fall-run chinook. Habitat blockage and degradation are significant problems in this ESU.

The median population growth rate over a base period from 1980 through 1998 ranges from 1.01 to 0.63, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (McClure *et al.* 2000).

Columbia River (CR) Chum Salmon

Chum salmon of the CR ESU spawn in tributaries and in mainstem areas below Bonneville Dam. Most fish spawn on the Washington side of the Columbia River (Johnson *et al.* 1997). Previously, chum salmon were reported in almost every river in the lower Columbia River Basin, but most runs disappeared by the 1950s (Rich 1942, Marr 1943, Fulton 1970). Currently, WDFW regularly monitors only a few natural populations in the basin, one in Grays River, two in small streams near Bonneville Dam, and the mainstem area next to one of the latter two streams. Recently, spawning has occurred in the mainstem Columbia River at two spots near Vancouver, Washington, and in Duncan Creek below the Bonneville Dam.

Historically, the CR chum salmon ESU supported a large commercial fishery in the first half of this century, landing more than 500,000 fish per year as recently as 1942. Commercial catches declined beginning in the mid-1950s and in later years rarely exceeded 2,000 per year. There are now no recreational or directed commercial fisheries for chum salmon in the Columbia River, although chum salmon are taken incidentally in the gill-net fisheries for coho and chinook salmon, and some tributaries have a minor recreational harvest (WDF *et al.* 1993). Observations of chum salmon still occur in most of the 13 basins/areas that were identified in 1951 as hosting chum salmon; however, fewer than 10 fish are usually observed in these areas. In 1999, the WDFW located another Columbia River mainstem spawning area for chum salmon near the I-205 bridge (WDFW 2000).

Chum salmon enter the Columbia River from mid-October through early December and spawn from early November to late December. Recent genetic analysis of fish from Hardy and Hamilton Creeks and from the Grays River indicate that these fish are genetically distinct from other chum salmon populations in Washington. Genetic variability within and between populations in several geographic areas is similar, and populations in Washington show levels of genetic subdivision typical of those seen between summer- and fall-run populations in other areas, and are typical of populations within run types (Salo 1991, WDF *et al.* 1993, Phelps *et al.* 1994, Johnson *et al.* 1997).

The median population growth rate is 1.04 over a base period from 1980 through 1998 for the ESU as a whole (McClure *et al.* 2000). Because census data are peak counts (and because the precision of those counts decreases markedly during the spawning season as water levels and turbidity rise), NOAA Fisheries is unable to estimate the risk of absolute extinction for this ESU.

Southern Oregon/Northern California Coasts (SONC) Coho Salmon

This ESU includes all naturally-spawned populations of coho salmon in coastal streams between Cape Blanco, Oregon, and Punta Gorda, California. In the 1940s, estimated abundance of coho salmon in this ESU ranged from 150,000 to 400,000 naturally-spawning fish. Today, coho populations in this ESU are very depressed, currently numbering approximately 10,000 naturally-produced adults. Although the Oregon portion of the coho salmon SONC ESU has declined drastically, the Rogue River Basin's portion increased substantially from 1974 to 1997. The bulk of current coho salmon production in this ESU consists of stocks from the Rogue River, Klamath River, Trinity River, and Eel River in Oregon.

Most SONC coho salmon enter rivers between September and February and spawn from November to January (occasionally into early spring). For many small streams in California that have sand bars at their mouths for much of the year except in winter, immigration is influenced by river flow (Weitkamp *et al.* 1995). Coho salmon eggs incubate for 35 to 50 days between November and March, and start emerging from the gravel 2 to 3 weeks after hatching (Hassler 1987). Following emergence, fry move into shallow areas near the streambanks. As the fry grow larger, they disperse up- and downstream to establish and defend a territory (Hassler 1987). During the summer, fry prefer pools and riffles with adequate cover. Juveniles overwinter in large mainstem pools, backwater areas, and secondary pools with large woody debris and undercut banks. Juveniles primarily eat aquatic and terrestrial insects (Sandercock 1991). After rearing in freshwater for up to 15 months, smolts enter the ocean between March and June (Weitkamp *et al.* 1995).

Oregon Coast (OC) Coho Salmon

This ESU is found in found in coastal streams draining the coast Range Mountains between Cape Blanco and the Columbia River. Estimated escapement of coho salmon in coastal Oregon was about 1.4 million fish in the early 1900s, with harvests of nearly 400,000 fish. Abundance of wild OC coho salmon declined during the period from about 1965 to 1975, and has fluctuated at a low level since that time (Nickelson *et al.* 1992). Production potential (based on stock-recruit models) shows a reduction of nearly 50% in habitat capacity. Spawner abundance estimates for naturally-produced OC coho for the past 13 years ranged from a low of 16,510 in 1990, to a high of nearly 239,000 in 2002 (ODFW 2003b).

Most OC coho salmon enter rivers from late September to mid-October after the onset of autumn freshets. Thus, a delay in fall rains will retard river entry and perhaps spawn timing. Peak spawning occurs from mid-November to early February. Depending on water temperature, eggs incubate for 35 to 50 days and start emerging from the gravel 2 to 3 weeks after hatching (Nickelson *et al.* 1992).

After they emerge, fry move into shallow areas near the streambanks. Juvenile rearing usually occurs in low gradient tributary streams, although they may move up to streams of 4 or 5% gradient. Juveniles have been found in streams as small as 1- to 2-m wide. When the fry are approximately 4 cm in length, they migrate upstream considerable distances to reach lakes or other rearing areas. Coho salmon fry prefer backwater pools during spring. In the summer, juveniles are more abundant in pools than in glides or riffles. During winter, the fishes predominate in off-channel pools of any type. Rearing in freshwater, which may take up to 15 months, is followed by migration to the sea as smolts between February and June (Weitkamp *et al.* 1995).

Middle Columbia River (MCR) Steelhead

The MCR ESU occupies the Columbia River Basin from above the Wind River in Washington and the Hood River in Oregon and continues upstream to include the Yakima River, Washington. The region includes some of the driest areas of the Pacific Northwest, generally receiving less than 40 cm of precipitation annually (Jackson 1993). Summer steelhead are widespread throughout the ESU; winter steelhead occur in Mosier, Chenowith, Mill, and Fifteenmile Creeks, Oregon, and in the Klickitat and White Salmon Rivers, Washington. The John Day River probably represents the largest native, natural spawning stock of steelhead in the region.

Estimates of historical (pre-1960s) abundance specific to this ESU are available for the Yakima River, which has an estimated run size of 100,000 (WDF *et al.* 1993). Assuming comparable run sizes for other drainage areas in this ESU, the total historical run size may have exceeded 300,000 steelhead (NOAA Fisheries 2000).

Life history information for this ESU has been summarized by NOAA Fisheries (2000). Most fish in this ESU smolt at two years and spend 1 to 2 years in salt water before reentering freshwater, where they may remain up to a year before spawning (Howell *et al.* 1985). All steelhead upstream of The Dalles Dam are summer-run (Schreck *et al.* 1986, Reisenbichler *et al.* 1992, Chapman *et al.* 1994, Busby *et al.* 1999). The Klickitat River, however, produces both summer and winter steelhead, and age-2-ocean steelhead dominate the summer steelhead, whereas most other rivers in the region produce about equal numbers of both age 1- and 2-ocean fish. A non-anadromous form co-occurs with the anadromous form in this ESU; information suggests that the two forms may not be isolated reproductively, except where barriers are involved.

Current population sizes are substantially lower than historic levels, especially in the rivers with the largest steelhead runs in the ESU, the John Day, Deschutes, and Yakima Rivers. At least two extinctions of native steelhead runs in the ESU have occurred (the Crooked and Metolius Rivers, both in the Deschutes River Basin). For the MCR steelhead ESU as a whole, NOAA Fisheries (2000) estimates that the median population growth rate over the base period (1990-1998) ranges from 0.88 to 0.75, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (McClure *et al.* 2000). In 2002, the count of Bonneville Dam steelhead totaled 481,036 and exceeded all counts recorded at Bonneville Dam since 1938, except the 2001 total, which was 633,464. Of the total return in 2002, 143,032 were considered wild steelhead (Fish Passage Center 2003a).

LCR Steelhead

The LCR ESU encompasses all steelhead runs in tributaries between the Cowlitz and Wind Rivers on the Washington side of the Columbia, and the Willamette and Hood Rivers on the Oregon side. The populations of steelhead that make up the LCR steelhead ESU are distinguished from adjacent populations by genetic and habitat characteristics. The ESU consists of summer and winter coastal steelhead runs in the tributaries of the Columbia River as it cuts through the Cascades. These populations are genetically distinct from inland populations (east of the Cascades), as well as from steelhead populations in the upper Willamette Basin and coastal runs north and south of the Columbia River mouth. Not included in the ESU are runs in the Willamette River above Willamette Falls (Upper Willamette River ESU), runs in the Little and Big White Salmon Rivers (Middle Columbia River ESU), and runs based on four imported hatchery stocks: early-spawning winter Chambers Creek/lower Columbia River mix, summer

Skamania Hatchery stock, winter Eagle Creek NFH stock, and winter Clackamas River ODFW stock (63 FR 13351 and 13352). This area has at least 36 distinct runs (Busby *et al.* 1999), 20 of which were identified in the initial listing petition. In addition, numerous small tributaries have historical reports of fish, but no current abundance data. The major runs in the ESU, for which there are estimates of run size, are the Cowlitz River winter runs, Toutle River winter runs, Kalama River winter and summer runs, Lewis River winter and summer runs, Washougal River winter and summer runs, Wind River summer runs, Clackamas River winter and summer runs, Sandy River winter and summer runs, and Hood River winter and summer runs (NOAA Fisheries 2000).

All runs in the LCR steelhead ESU have declined from 1980 to 2000, with sharp declines beginning in 1995 (NOAA Fisheries 2000). Historic counts in some of the larger tributaries (Cowlitz, Kalama, and Sandy Rivers) probably exceeded 20,000 fish; more recent counts have been in the range of 1,000 to 2,000 fish (NOAA Fisheries 2000). Habitat loss, hatchery steelhead introgression, and harvest are the major contributors to the decline of steelhead in this ESU. For the LCR steelhead ESU, NOAA Fisheries (2000) estimates that the median population growth rate over the base period (1990-1998) ranges from 0.98 to 0.78, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (McClure *et al.* 2000).

UWR Steelhead

The UWR steelhead ESU occupies the Willamette River and tributaries upstream of Willamette Falls, extending to and including the Calapooia River. These major river basins containing spawning and rearing habitat comprise more than 12,000 km^2 in Oregon. Rivers that contain naturally-spawning winter-run steelhead include the Tualatin, Molalla, Santiam, Calapooia, Yamhill, Rickreall, Luckiamute, and Mary's, although the origin and distribution of steelhead in a number of these basins is being debated. Early migrating winter and summer steelhead have been introduced into the upper Willamette basin, but those components are not part of the ESU. Native winter steelhead within this ESU have been declining since 1971, and have exhibited large fluctuations in abundance.

Over the past several decades, total abundance of natural late-migrating winter steelhead ascending the Willamette Falls fish ladder has fluctuated several times over a range of approximately 5,000 to 20,000 spawners. However, the last peak occurred in 1988, and this peak has been followed by a steep and continuing decline. Abundance in each of year from 1993 to 1998, was below 4,300 fish, and the run in 1995 was the lowest in 30 years.

In general, native steelhead of the UWR are late-migrating winter steelhead, entering freshwater primarily in March and April. This atypical run timing appears to be an adaptation for ascending Willamette Falls, which functions as an isolating mechanism for UWR steelhead. Reproductive isolation resulting from the falls may explain the genetic distinction between steelhead from the upper Willamette River Basin and those in the lower river. UWR late-migrating steelhead are ocean-maturing fish. Most return at age 4, with a small proportion returning as 5-year-olds (Busby *et al.* 1999). Willamette Falls (Rkm 77) is a known migration barrier (NOAA Fisheries

2000). Winter steelhead and spring chinook salmon historically occurred above the falls, whereas summer steelhead, fall chinook, and coho salmon did not. Detroit and Big Cliff Dams cut off access to 540 km of spawning and rearing habitat in the North Santiam River. In general, habitat in this ESU has become substantially simplified since the 1800s by removal of large woody debris to increase the river's navigability.

Habitat loss, hatchery steelhead introgression, and harvest are the major contributors to the decline of steelhead in this ESU. For the UWR steelhead ESU, the estimated median population growth rate for 1990-1998 ranged from 0.94 to 0.87, decreasing as the effectiveness of hatchery fish spawning in the wild increased compared with that of fish of wild origin (McClure *et al.* 2000).

UCR Steelhead

This inland steelhead ESU occupies the Columbia River Basin upstream from the Yakima River to the U.S./Canada border. Rivers in the area primarily drain the east slope of the northern Cascade Mountains and include the Wenatchee, Entiat, Methow, and Okanogan River Basins.

Estimates of historical (pre-1960s) abundance specific to this ESU are available from fish counts at dams (NOAA Fisheries 2000). Counts at Rock Island Dam from 1933 to 1959 averaged 2,600 to 3,700, suggesting a pre-fishery run size exceeding 5,000 adults for tributaries above Rock Island Dam (Chapman *et al.* 1994, Busby *et al.* 1999). Lower Columbia River harvests had already depressed fish stocks during the period in which these counts were taken, thus, the pre-fishery estimate should be viewed with caution.

Habitat degradation, juvenile and adult mortality in the hydropower system, and unfavorable environmental conditions in both marine and freshwater habitats have contributed to the declines and represent risk factors for the future. Harvest in lower river fisheries and genetic homogenization from composite broodstock collection are other factors that may contribute significant risk to the UCR steelhead ESU.

The median population growth rate over a base period from 1990 through 1998 ranged from 0.94 to 0.66, decreasing as the effectiveness of hatchery fish spawning in the wild increased compared with that of fish of wild origin (Tables B-2a and B-2b in McClure *et al.* 2000). In 2002, 15,286 steelhead were counted at Rock Island Dam, compared with the 2001 count of 28,602, and the 10-year average return of 9,165. Of the total steelhead counted at Rock Island Dam in 2002, 10,353 were wild steelhead (Fish Passage Center 2003).

Critical Habitat

NOAA Fisheries designates critical habitat based on physical and biological features that are essential to the listed species. For this Opinion, NOAA Fisheries has designated critical habitat for SR sockeye salmon, SR spring/summer chinook salmon, SR steelhead, and SONC coho salmon. The essential features of designated critical habitat within the action area that support successful spawning, incubation, fry emergence, migration, holding, rearing, and smoltification for ESA-listed salmonid fishes include: (1) Substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food (primarily juvenile), (8) riparian vegetation, (9) space, and (10) safe passage conditions.

2.1.2 Evaluating Proposed Actions

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA as defined by 50 CFR 402.02 (the consultation regulations). In conducting analyses of habitat-altering actions under section 7 of the ESA, NOAA Fisheries uses the following steps of the consultation regulations and when appropriate combines them with its Habitat Approach (NOAA Fisheries 1999): (1) Consider the biological requirements of the listed species; (2) evaluate the relevance of the environmental baseline in the action area to the species' current status; (3) determine the effects of the proposed or continuing action on the species; and (4) determine whether the species can be expected to survive with an adequate potential for recovery under the effects of the proposed or continuing action, the effects of the environmental baseline, and any cumulative effects, and considering measures for survival and recovery specific to other life stages. In completing this step of the analysis, NOAA Fisheries determines whether the action under consultation, together with cumulative effects when added to the environmental baseline, is likely to jeopardize the ESA-listed species. The fourth step, above, requires a two-part analysis. The first part focuses on the action area and defines the proposed action's effects in terms of the species' biological requirements in that area (*i.e.*, effects on essential habitat features). The second part focuses on the species itself. It describes the action's effects on individual fish–or populations, or both–and places these effects in the context of the ESU as a whole. Ultimately, the analysis seeks to answer the question of whether the proposed action is likely to jeopardize a listed species' continued existence. If so, step 5 occurs. In step 5, NOAA Fisheries may identify reasonable and prudent alternatives for the action that avoid jeopardy, if any exist.

2.1.3 Biological Requirements

The first step in the methods NOAA Fisheries uses for applying the ESA section 7(a)(2) to listed salmon is to define the species' biological requirements that are most relevant to each consultation. NOAA Fisheries also considers the current status of the listed species taking into account population size, trends, distribution and genetic diversity. To assess to the current status of the listed species, NOAA Fisheries starts with the determinations made in its decision to list the species for ESA protection and also considers new data available that is relevant to the determination.

The biological requirements of a listed species are population characteristics necessary for salmon and steelhead to survive and recover to naturally-reproducing population levels, at which time protection under the ESA would become unnecessary. These requirements are best defined as the attributes associated with viable salmonid populations. Viable salmonid populations are populations that have a negligible risk of extinction due to threats from demographic variation (random or directional), local environmental variation, and genetic diversity changes (random or directional) over a 100-year time frame. The attributes associated with viable salmonid populations include adequate abundance, productivity (population growth rate), population spatial scale, and genetic diversity (McElhany *et al.* 2000). These attributes are influenced by survival, behavior and experiences throughout the life cycle and by all action affecting the species, and are therefore distinguished from the more specific biological requirements associated with the action area. However, it is important that the action-area effects be considered in the context of these species-level biological requirements when evaluating the potential for the species to survive and recover (*i.e.*, in the context of the full set of human activities and environmental conditions affecting the species). Biological requirements may also be described as characteristics of the habitat for actions that primarily affect survival through habitat pathways.

The current status of each species (Table 1) indicates that the species-level biological requirements currently are not being met for any of the ESUs considered in this consultation. This indicates that improvements in survival rates (assessed over the entire life cycle) will be needed to meet species-level biological requirements in the future. NOAA Fisheries will assess survival improvements necessary in the life stages influenced by the proposed action after considering the environmental baseline, which is specific to the area affected by the proposed action

2.1.4 Environmental Baseline

Regulations implementing section 7 of the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, state, or private actions and other human activities in the action area. The environmental baseline also includes the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation, and the impacts of state and private actions that are contemporaneous with the consultation in progress.

Populations of anadromous salmonids are at risk or already extinct in many river basins of Oregon, leading to the numerous ESA listings for anadromous fish (Table 1). These populations have declined due to a variety of human activities and natural events including hydropower development, overharvest, land management activities, artificial propagation, water pollution, disease, predation, competition from introduced species, and climatic variation leading to temporarily unfavorable ocean conditions (FEMAT 1993, Henjum *et al.* 1994, NOAA Fisheries 1995, National Research Council 1996, Spence *et al.* 1996, Oregon Coastal Salmon Restoration Initiative 1997, Lee *et al.* 1997).

Land Management

Land management activities that have degraded habitat of anadromous salmonids include water withdrawals, unscreened water diversions, hydropower development, road construction, timber harvest, stream cleaning of large wood, splash dams, mining, farming, livestock grazing, outdoor recreation, and urbanization (FEMAT 1993, Botkin *et al.* 1995, National Research Council 1996, Spence *et al.* 1996, Lee *et al.* 1997). In many Oregon basins, land management activities have: (1) Reduced connectivity (*i.e.*, the flow of energy, organisms, and materials) between streams, riparian areas, floodplains, and uplands; (2) elevated fine sediment yields, filling pools and reducing spawning and rearing habitat; (3) reduced instream and riparian large woody debris that traps sediment, stabilizes streambanks, and helps form pools; (4) reduced or eliminated vegetative canopy that minimizes temperature fluctuations; (5) caused streams to become straighter, wider, and shallower, which has the tendency to reduce spawning and rearing habitat and increase temperature fluctuations; (6) altered peak flow volume and timing, leading to channel changes and potentially altering fish migration behavior; (7) altered floodplain function, water tables and base flows, resulting in riparian wetland and stream dewatering; and (8) degraded water quality by adding heat, nutrients and toxicants (FEMAT 1993, Henjum *et al.* 1994, McIntosh *et al.* 1994, Rhodes *et al.* 1994, Wissmar *et al.* 1994, National Research Council 1996, Spence *et al.* 1996, Oregon Coastal Salmon Restoration Initiative 1997, Lee *et al.* 1997).

Beginning in the early 1800s, riparian areas in eastern and southern Oregon were extensively changed by trapping beaver, logging, mining, livestock grazing, agricultural activities, and associated water diversion projects. Very little of the once extensive riparian vegetation remains to maintain water quality and provide habitats for threatened salmon. Dams have affected flow, sediment, and gravel patterns, which in turn have diminished regeneration and natural succession of riparian vegetation along downstream rivers. Introduced plant species pose a risk to some riparian habitat by dominating local habitats and reducing the diversity of native species. Improper grazing management in riparian areas is another significant threat (Risser 2000).
In the Columbia River Basin, even before mainstem dams were built, habitat was lost or severely damaged in small tributaries by construction and operation of irrigation dams and diversions, inundation of spawning areas by impoundments, and siltation and pollution from sewage, farming, logging, and mining (Fulton 1968).

Human activities have had vast effects on the salmonid populations in the Willamette River basin. First, the Willamette River, once a highly braided river system, has been dramatically simplified through channelization, dredging, and other activities that have reduced rearing habitat (*i.e.*, stream shoreline) by as much as 75%. In addition, the construction of 37 dams in the basin has blocked access to over 435 miles of stream and river spawning habitat. The dams also alter the temperature regime of the Willamette and its tributaries, affecting the timing of development of naturally-spawned eggs and fry. Water quality is also affected by development and other economic activities. Agricultural and urban land uses on the valley floor, as well as timber harvesting in the Cascade and Coast ranges, contribute to increased erosion and sediment load in Willamette River basin streams and rivers. Finally, since at least the 1920s, the lower Willamette River has suffered municipal and industrial pollution (Risser 2000).

In the western Cascades, Willamette Valley, Coast Range, and Klamath Mountains, riparian areas on privately-owned land are dominated by younger forests because of timber harvest, whereas riparian areas on public lands have more mature conifers. Old coniferous forests now comprise approximately 20% of the riparian forests in the Cascades, but only 3% in the Coast Range. Older forests historically occurred along most of the McKenzie River, but now account for less than 15% of its riparian forests. Along the mainstem of the upper Willamette River, channel complexity has been reduced by 80% and the total area of riparian forest has been reduced by more than 80% since the 1850s. Downstream portions of the Willamette River have experienced significant channel change, and more than 80% of the historical riparian forest has been lost (Risser 2000).

Depending on the species, salmon spend from a few days to one or 2 years in an estuary before migrating out to the ocean. However, alterations such as filling, dredging, the introduction of nonnative species, and excessive waste disposal have changed Oregon's estuaries, reducing their natural resiliency and functional capacity. The most significant historical changes in Oregon's estuaries are the diking, draining and filling of wetlands and the stabilization, dredging and maintenance of navigation channels. Between 1870 and 1970, approximately 50,000 acres, or 68% of the original tidal wetland areas in Oregon estuaries, were lost. Consumptive use of fresh water in the upper watersheds has reduced freshwater inflow to estuaries by as much as 60 to 80%, thus reducing the natural dilution and flushing of pollutants. Non-native species now comprise a significant portion of Oregon's estuarine flora and fauna. Some, such as the European green crab, pose serious threats to the native estuarine communities. Despite these significant historical wetland conversions and continuing degradation by pollutants, nuisance species, and navigational improvement, much of the original habitat that existed in the mid-1800s is still relatively intact. Hundreds of acres of former estuarine marshes are now being restored (Risser 2000).

Oregon contains approximately 114,500 miles of rivers and streams. No statewide measurements exist of the area of riparian vegetation, although some estimates have been made for more localized regions. Using the conservative estimate of a 100-yard riparian corridor on each side of the stream, the total area of riparian habitats for flowing water in Oregon may be 22,900 square miles. That is equal to approximately 15% of the total area of the state. With the exception of fall chinook, which generally spawn and rear in the mainstem, most salmon and steelhead spawning and rearing habitat is found in tributaries where riparian areas are a major habitat component. Healthy riparian areas retain the structure and function of natural landscapes as they were before the intensive land use and land conversion that has occurred over the last 150 to 200 years. However, land use activities have reduced the numbers of large trees, the amount of closed-canopy forests, and the proportion of older forests in riparian areas. In western Oregon, riparian plan communities have been altered along almost all streams and rivers (Risser 2000).

Water Supply

Oregon's currently available water supplies are fully or over allocated during low flow months of summer and fall. In the Columbia Plateau ecoregion, less that 20% of instream water rights can expect to receive their full allocation nine months of the year. In the Willamette Valley and Cascades ecoregions, more than 80% of the instream water rights can expect to receive their full allocation in the winter, but only about 25% in the early fall. Increased demand for water is linked to the projected 34% increase in human population over the next 19 years in the state (Oregon Department of Administrative Services 1999). Depletion and storage of natural flows have altered natural hydrological cycles in basins occupied by listed ESUs. This may cause juvenile salmon mortality through migration delay resulting from insufficient flows or habitat blockages, loss of sufficient habitat due to dewatering and blockage, stranding of fish resulting from rapid flow fluctuations, entrainment of juveniles into poorly screened or unscreened diversions, and increased juvenile mortality resulting from increased water temperatures (Spence *et al.* 1996). Reduced flows also negatively affected fish habitats due to increased deposition of fine sediments in spawning gravels, decreased recruitment of new spawning gravels, and encroachment of riparian and exotic vegetation into spawning and rearing areas. Further, some climate models predict 10 to 25% reductions in late spring-summer-early fall runoff amounts in the coming decades (Risser 2000).

Water Quality

The Oregon Water Quality Index (OWQI) is based on a combination of measurements of temperature, dissolved oxygen, biochemical oxygen demand, pH, ammonia and nitrate nitrogen, total phosphorus, total solids and fecal coliform (Risser 2000). Generally, water quality in Oregon, as shown by the OWQI, is poor for salmon during low flow periods, except in mountainous areas. Areas with excellent or good water quality occur most often in forested uplands. Poor or very poor water quality occurs most often in non-forested lowlands where land has been converted to agricultural and urban uses. Most ecoregions include some rivers and streams with excellent water quality and other with very poor water quality. Only the Cascades ecoregion has excellent water quality overall. The Willamette Valley, Columbia Plateau, Northern Basin and Range, and southern end of the Eastern Cascade Slope ecoregions have poor water quality. The effects of pesticides and fertilizers, especially nitrates, on aquatic habitats are a significant concern (Risser 2000).

Exotic Species

More than 32 species of freshwater fish have been introduced into Oregon, and are now self-sustaining, making up approximately one-third of Oregon's freshwater fish fauna. Introduced species are frequently predators on native species, compete for food resources, and alter freshwater habitats. In 1998, introduced species were found to comprise 5% of the number of species found in the upper Willamette River, but accounted for 60% of the observed species in the lower river near Portland. Flow conditions and water quality are poor and riparian structure and function has been significantly degraded from historical conditions. These and other problems reflect the aggregate effects of many small, diffuse, individual decisions and actions (Risser 2000).

Summary of Environmental Baseline

Based on the information summarized in this section, not all of the biological requirements of the listed and proposed species for freshwater habitat in general, water quality in particular, are being met under the environmental baseline in many streams and watersheds occupied by listed salmon and steelhead in Oregon. Their status is such that there must be a significant improvements in the environmental conditions they experience, over those currently available under the environmental baseline, to meet the biological requirements for survival and recovery of these species. Any further degradation of these conditions would significantly reduce the likelihood of survival and recovery of these species due to status of the environmental baseline.

2.1.5 Analysis of Effects

The ESA Section 7 implementing regulations (50 CFR 402.02) define "effects of the action" as:

> The direct and indirect effects of an action on the species or critical habitat together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline. The environmental baseline includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 CFR 402.02).

EPA's approval of Oregon's revised water quality standards would have no direct effects to ESA-listed species or their habitat – that is, approving new water quality standards, by itself, will not directly affect listed species or designated critical habitat, or change the environmental baseline. However, there are significant indirect effects of approving the standards, because the approval allows the state to implement the standards. This includes evaluations and listings for the CWA §303(d) list of impaired waters, and development of total maximum daily loads (TMDLs), national pollution discharge elimination system (NPDES) permits, and non-point source pollutant control plans that are designed to meet the standards over time.

The analysis of effects of the proposed action assumes that the species of interest are exposed to waters meeting the water quality standards, however, there are many waters in Oregon that do not meet the current standards and would not meet the proposed standards. Implementation and attainment of the standards are key to improving the state's water quality, however, the only action under consideration in this consultation is EPA's proposed approval of Oregon's revised standards. As Oregon completes TMDLs designed to meet the revised standards, issues or reissues permits in conjunction with those TMDLs, and incorporates nonpoint source controls adequate to meet water quality standards, the condition of impaired waters, and thus the environmental baseline, is likely to improve.

As stated above, NOAA Fisheries considers the Temperature Guidance to include the best available scientific information on the thermal requirements of salmon and steelhead and on how to construct state or tribal water quality criteria, and we strongly considered the degree of consistency with this document in our review of Oregon's revised temperature standard.

2.1.5.1 Effects of the Proposed Action

2.1.5.1.1 Definitions: OAR 340-041-0002

Oregon submitted to EPA definitions for 20 terms that are used in Oregon's temperature standard, which has also been submitted for EPA's approval. The specific terms are: Ambient stream temperature, applicable criteria, basin, cold water aquatic life, cold water refugia, cool water aquatic life, core cold water habitat use, critical habitat, migration corridors, natural conditions, natural thermal potential, nonpoint sources, point source, salmon and steelhead spawning use, salmon and trout rearing and migration use, salmonid or salmonids, seven-day average maximum temperature, subbasin, summer, and threatened or endangered species. EPA analyzed the indirect effects (implementation) of the above definitions as part of the analysis of the rule provisions to which they apply. In its BE, EPA determined that the definitions, by themselves, will have no effect on the subject threatened and endangered species. The use of these definitions in the water quality standards criteria is discussed below.

2.1.5.1.2 Antidegradation OAR 340-041-0004

The following provisions apply to all water quality criteria in the Oregon rules (*i.e.*, they are not limited to temperature and IGDO). OAR 340-041-0004 includes the following provisions that EPA proposes to approve.

Tier 1– Water Quality Limited Waters
Oregon's Tier 1 language states: "Water quality limited waters may not be further degraded except in accordance with section (9)(a)(B), (C) and (D) of this rule" (these pertain to exemptions and exceptions). Under Oregon's regulations (OAR 340-041-0006(30)), "Water Quality Limited" can include any of the following:

(a) A receiving stream which does not meet instream water quality standards during the entire year or defined season even after the implementation of standard technology.

(b) A receiving stream which achieves and is expected to continue to achieve instream water quality standard but utilizes higher than standard technology to protect beneficial uses.

(c) A receiving stream for which there is insufficient information to determine if water quality standards are being met with higher than standard treatment technology or where through professional judgment the receiving stream would not be expected to meet water quality standards during the entire year or defined season without higher than standard technology.

EPA interprets Tier 1 as the "floor" of water quality protection afforded to all waters of the United States. Section 1 in Oregon's antidegradation implementation methods states that part of the purpose of the antidegradation policy is "... to protect, maintain, and enhance existing surface water quality to ensure the full protection of all existing beneficial uses."

In its BE, EPA determined that the Tier 1 provision may affect, but is not likely to adversely affect the subject threatened and endangered species. Oregon goes beyond minimum requirements by including the following language in section 9(a)(C): "The new or increased discharged load would not unacceptably threaten or impair any recognized beneficial uses or adversely affect threatened or endangered species." Section 9(a)(D), which is referenced by Oregon's Tier 1 language, also includes consideration of threatened or endangered species (see discussion under "Policies that apply to both Tier 1 and Tier 2" below). Based on this information, and constraints on exemptions to antidegradation requirements in Tier 1 waters (see discussion under "Policies that apply to both Tier 1 and Tier 2" below), NOAA Fisheries concurs with EPA's determination of effect. The 2-year review (discussed in EPA CM 3, and in the February 5, 2004, letter from Mike Llewelyn, ODEQ, to Randy Smith, EPA Region 10) represents an opportunity to confirm that ODEQ is implementing the antidegradation rules in a manner that is consistent with the scope of the analysis of effects and conclusion described in this Opinion.

Tier 2 –High Quality Waters

Oregon defines a high quality water as one that has water quality that *meets or is better than* all water quality standards. Therefore, a high quality water is one that is not a water quality-limited water or a State Outstanding Resource Water. The purpose of EPA's antidegradation regulations with regard to high quality waters is to ensure that assimilative capacity in the waterbody is not used up without a public process to determine that lowering water quality is necessary to accommodate important social or economic development. Under the requirements of the of the ODEQ's Antidegradation Policy Implementation Internal Management Directive[2] (Management Directive) for NPDES permits and CWA section 401 water quality certifications, a discharger/applicant must demonstrate that there are no alternatives to lowering water quality and that economic benefits of lowering water quality are greater than other uses of the assimilative capacity. Section 6(d) goes above and beyond the basic requirements of Tier 2 by stating that the state will allow a lowering of water quality only if threatened or endangered species would not be adversely affected.

EPA's regulations do not require specific elements in antidegradation implementation methods, so EPA's discretion is limited to ensuring the methods are consistent with the intent of the antidegradation policy. The Oregon antidegradation rules include discretion needed for ODEQ to implement the water quality standards. Since EPA lacks the authority to oversee implementation of state water quality standards, the discretion in the Oregon antidegradation rules represents a source of uncertainty regarding the effects of these provisions.

In its BE, EPA determined that the Tier 2 provision may affect, but is not likely to adversely affect the subject threatened and endangered species. NOAA Fisheries worked closely with ODEQ on development of its Directive and believes that the procedures generally are appropriate given the framework of the CWA and the extent of ODEQ's authorities. The inclusion of provisions to avoid adversely affecting threatened or endangered species goes beyond the CWA requirement to protect existing beneficial uses and likely will help ensure that the needs of listed species will be considered, although ODEQ has not developed procedures for making such

[2] The Management Directive is online at http://www.deq.state.or.us/wq/standards/AntidegPolicyDirect.pdf

findings. Based on this information, NOAA Fisheries concurs with EPA's determination of effect. The two-year review (discussed in EPA CM 3, and in the February 5, 2004, letter from Mike Llewelyn, ODEQ, to Randy Smith, EPA Region 10) represents an opportunity to confirm that ODEQ is implementing the antidegradation rules in a manner that is consistent with the scope of the analysis of effects and conclusion described in this Opinion.

<u>Policies that apply to both Tier 1 and Tier 2</u>
Oregon's policies that apply to both Tier 1 and Tier 2 include the growth policy, non-degradation discharges, recurring activities, exemptions and exceptions.

As noted in the previous sections, both Tier 1 and Tier 2 contain provisions that provide additional consideration for the protection to threatened or endangered species. Sections 3(b) and (d) also specifically consider threatened and endangered species by waiving antidegradation review for water conservation activities and *de minimis* DO contributions[3] only where the action will not adversely affect threatened or endangered species. Section 5 (Exemptions to the Antidegradation Requirement) specifies that to be exempt from antidegradation review, the activities and situations for short-term exemptions must demonstrate that they have minimized adverse effects to threatened and endangered species.

Under section 9 of the antidegradation rules, Oregon's Environmental Commission (Commission) or the ODEQ may grant exceptions to this rule and thereby allow new or increased discharged loads so long as the Commission or ODEQ makes the following findings:

(A) The new or increased discharged load will not cause water quality standards to be violated.

(B) The action is necessary and benefits of the lowered water quality outweigh the environmental costs of the reduced water quality. This evaluation will be conducted in accordance with ODEQ's "Antidegradation Policy Implementation Internal Management Directive for NPDES Permits and section 401 water quality certifications," pages 27, and 33-39 (March 2001) incorporated herein by reference.

(C) The new or increased discharged load will not unacceptably threaten or impair any recognized beneficial uses or adversely affect threatened or endangered species.

Under "extraordinary circumstances" to solve an existing, immediate and critical environmental problem, the EQC or DEQ may, after the completion of a TMDL but before the waterbody has achieved compliance with standards, consider a waste load increase for an existing source on a

[3] Section 3(d) in ODEQ's Directive states: "No measurable reduction of dissolved oxygen. No measurable reduction is defined as : No more than 0.10 mg/L for a single source and no more than 0.20 mg/L for all anthropogenic activities that influence the water quality limited segment."

receiving stream designated "water quality limited." This action depends on an evaluation that shows that the increased load will not adversely affect threatened or endangered species.

In its BE, EPA concluded that Oregon's antidegradation implementation methods would protect existing uses and the level of water quality necessary to protect existing uses, including threatened or endangered species, and would provide a means for assessing activities that may affect high quality waters and for ruling on whether such projects could proceed. EPA determined that the Tier 1 and Tier 2 policies may affect, but are not likely to adversely affect the subject threatened and endangered species. Regarding exceptions to the antidegradation rule, under the ODEQ's Management Directive, a discharger/applicant must demonstrate that there are no alternatives to lowering water quality and that economic benefits of lowering water quality are greater than other uses of the assimilative capacity. NOAA Fisheries worked closely with ODEQ on its development of its Management Directive and believes that the procedures generally are appropriate given the framework of the CWA and the extent of ODEQ's authorities, and should serve to minimize exceptions to antidegradation requirements. The inclusion of provisions to avoid adversely affecting threatened or endangered species likely will help ensure that the needs of listed species will be considered by the ODEQ and EQC in their reviews, although ODEQ has not developed procedures for making such findings. Based on this information, NOAA Fisheries concurs with EPA's determination of effect.

EPA's regulations do not require specific elements in antidegradation implementation methods, so EPA's discretion is limited to ensuring the methods are consistent with the intent of the antidegradation policy. The Oregon antidegradation rules include discretion needed for ODEQ to implement the water quality standards. Since EPA lacks the authority to oversee implementation of state water quality standards, the discretion in the Oregon antidegradation rules represents a source of uncertainty regarding the effects of these provisions. The two-year review (discussed in EPA CM 3, and in the February 5, 2004, letter from Mike Llewelyn, ODEQ, to Randy Smith, EPA Region 10) represents an opportunity to confirm that ODEQ is implementing the antidegradation rules in a manner that is consistent with the scope of the analysis of effects and conclusion described in this Opinion.

Tier 3 –Outstanding Resource Waters

Oregon defines outstanding resource waters as "those waters designated by the Environmental Quality Commission where existing high quality waters constitute an outstanding state or national resource based on their extraordinary water quality or ecological values, or where special water quality protection is needed to maintain critical habitat areas" (OAR 340-041-0006(42). Oregon added state wildlife refuges and federally-designated wilderness areas to the list of priority waterbodies for nomination. Where threatened or endangered species exist in these areas, the Outstanding Resource Water designation prevents any degradation of water quality and provides rigorous protection for these species.

In its BE, EPA determined that the Tier 3 – water quality limited waters provision may affect, but is not likely to adversely affect the subject threatened and endangered species. Therefore, because no degradation of these waters is permitted, NOAA Fisheries concurs with EPA's determination.

2.1.5.1.3 Intergravel Dissolved Oxygen OAR 340-041-0016(1)(a)(c)

OAR 340-041-0016(1)(a)(c) includes the following revised provisions for intergravel dissolved oxygen (IGDO) that EPA proposes to approve:

(a) For waterbodies identified as active spawning areas.
(C) The spatial median intergravel dissolved oxygen concentration must not fall below 8.mg/l.

The early life stages of fish require relatively high concentrations of dissolved oxygen (DO). DO measured within gravel beds is called intergravel dissolved oxygen. The purpose of the IGDO criterion is to protect salmonid eggs and fry from low IGDO in redds.

The DO demand of embryos increases as temperature increases and as developmental stages progress, with the greatest demand just before hatching (Rombough 1986). At 15° C, the critical level of IGDO (where ambient levels meet metabolic needs) for steelhead increases from 1.0 mg/L shortly after fertilization to greater than 9.7 mg/L before hatching.

Low concentrations of IGDO increase the acute toxicity of various toxicants such as metals (*e.g.*, zinc) and ammonia (ODEQ 1995). Low IGDO concentrations may increase uptake of waterborne-toxics because of increased ventilation rates across the gills. Chemicals that damage the gill epithelium may decrease the efficiency of oxygen uptake, causing increased sensitivity to low IGDO. Exposure to some chemicals, such as pentachlorophenol, a common wood preservative, can increase metabolic oxygen demand by interfering with cellular oxidative phosphorylation. Rainbow trout eggs excrete most of their nitrogenous wastes as ammonia (Carson 1985). Eggs in redds exposed to ammonia under conditions of low IGDO concentrations and low water velocity may experience ammonia toxicity due to insufficient oxygen to nitrify ammonia. In addition, under these conditions, ammonia nitrification can further reduce already-low IGDO.

Based on studies with coho salmon, late-emerging alevins and small-sized fry are poor competitors and face almost certain death from predation, disease, starvation, or a combination of these (Mason 1969, Chapman and McLeod 1987). Alevin size at emergence is correlated with IGDO concentration (Turnpenny and Williams 1980). Growth (length) of brown trout alevins was lower at IGDO concentrations of 6 to 7 mg/L than at IGDO concentrations of 9 to 10 mg/L (Maret *et al.* 1993). Alevins raised at low DO concentrations were smaller; however, the fish eventually reached nearly the same weight as fish incubated at higher DO concentrations (Brannon 1965).

Intergravel water velocity in the redd and observed IGDO concentration appear to be closely related (Coble 1961), making it difficult to separate the influence of these two variables on observed survival (ODEQ 1995). The effect of water velocity on developing embryos can be attributed to its role in transferring sufficient amounts of DO to the surface of the egg membrane and removing waste products (Brannon 1965). A field study of rainbow trout embryos indicated 50% embryo survival at an IGDO concentration of 8 mg/L and seepage velocities exceeding 100 cm/hr (Sowden and Power 1985). The authors also reported that survival was negligible at intergravel water velocities below 20 cm/hr.

A study in spawning habitat of brown trout in Idaho found a significant relationship between IGDO and survival (Maret *et al.* 1993). Survival was negligible when mean IGDO fell below 8.0 mg/L. Maret *et al.* (1993) suggest that growth and survival were positively correlated to IGDO concentrations above 8.0 mg/L when seepage velocities exceeded 100 cm/hr. Survival was also inversely related to the amount of fine substrate sediment. IGDO in natural redds with wild brook trout was usually above 6.0 mg/L and survival of embryos was directly related to mean IGDO up to 8.0 to 9.0 mg/L (Hollender 1981, as cited in ODEQ 1995). Artificial redds used in this study produced much lower survival, but also indicated negligible survival below about 8.0 mg/L. Few or no steelhead sac fry were recovered from containers placed in streambed gravels where mean IGDO was below 8 mg/L (Phillips and Campbell 1962). About 35% of juvenile trout survived at IGDO concentration of 6 mg/L and approximately 95% survived when the IGDO concentration was 8 mg/L (Turnpenny and Williams1980). Results from Sowden and Power (1985), Phillips and Campbell (1962), and Turnpenny and Williams (1980) suggest that IGDO concentrations of less than 5 mg/l are lethal. These three studies had limited data concerning survival rates at IGDO concentrations above 8 mg/L that could be compared to the findings of Hollender (1981) and Maret *et al.* (1993).

Regarding the question of possible thresholds for IGDO-related effects to salmonid embryos and alevins, the studies cited above did not use standardized methodologies and their results must be considered in light of certain methodological problems. Spatial variability of IGDO in redds is high, due to variable biological oxygen demand, dilution with ground water, periphyton on and near the gravel surface, and gravel permeability (Vaux 1962). Also, productive streams exhibit diurnal cycles in DO concentrations due to photosynthesis and respiration. Average measures of DO concentration do not reflect the damage to aquatic life that can occur during diurnal minima. Many of the studies described in this section, such as Phillips and Campbell and Maret *et al.*, did not account for such confounding variables. For example, standpipes used in artificial redds (*e.g.*, in Phillips and Campbell 1962) create different conditions than occur in natural redds and do not take into account spatial variability. Samples were taken using a modified Winkler titration method at intervals throughout 10 days and 5 days, but the exact interval was not specified, so it is impossible to determine at which points in the diurnal cycle of IGDO variation the samples were taken. Samples taken during mid-day possibly could be biased towards higher IGDO values that would not be representative of the average conditions experienced by embryos and alevins in the gravel.

Maret *et al.* (1993) sampled using a hand pump on a biweekly basis. Using this sampling regime, it is impossible to properly account for temporal variability in IGDO. High variability in salmonid embryo survival at the control station (18 to 83% mortality) implies that there were are other unmeasured factors (such as predation by macro invertebrates, disease, and handling damage) that contributed to the mortality of the developing embryos. Finally, many of the above studies involved resident, not anadromous, salmonid species.

EPA's national quality Criteria for Water include recommendations for DO criteria in the water column that assume a loss of at least 3 mg/L from the water column to the intergravels. Since IGDO concentration is inversely related to the percent of organic fine materials in sediments (Skaugset 1980, as cited in ODEQ 1995), the estimated loss of 3 mg/L may underestimate the loss in streams with heavy fine sediment loads.

Based on the above information, IGDO thresholds cannot conclusively be established for Pacific salmon and steelhead, although positive relationships between IGDO and both survival and growth of salmonid fishes are evident. Also lacking are baseline data on ambient IGDO within natural and impaired spawning sites. Additional research is needed on Pacific salmonid species over a wider geographic area to validate specific protocols for IGDO (Maret *et al.* 1993).

In its BE, EPA determined that the IGDO criterion may affect, but is not likely to adversely affect the subject threatened and endangered species. Based on the results of studies of natural redds, and on the results of studies using artificial redds, the ODEQ criterion of 8.0 mg/L, measured as a spatial median, will prevent high mortality of salmon and steelhead embryos and alevins, but may not provide adequate levels of IGDO for embryos and alevins of listed salmon and steelhead at all times (particularly during the brief period of maximum summer water temperatures) and in all places used for spawning and incubation. Due to the natural high variability in IGDO, stream reaches areas meeting the criterion will include localized areas of lower IGDO. Because of these factors, NOAA Fisheries does not concur with EPA's determination of effect. Establishment of a consistent monitoring and sampling protocol and implementation of this criterion by ODEQ could contribute much-needed information regarding existing IGDO concentrations in Oregon rivers with various amounts of fine substrate sediment and stream velocities.

2.1.5.1.4 Temperature OAR 340-041-0028

Oregon's Metric: Maximum Seven-day Average of the Daily Maximum

Oregon's metric for its revised numeric temperature criteria, maximum seven-day average of the daily maximum (7DADM) is the same as the metric EPA recommended in the Temperature Guidance (EPA 2003). This metric is oriented to daily maximum temperatures, so it can be used to protect against acute effects, such as lethality and migration blockage. The 7DADM metric reflects the maximum temperatures in a stream, but is not overly influenced by the maximum temperature of a single day. Thus, it reflects an average of maximum temperatures that fish are exposed to over a week-long period.

This metric can also be used with regard to sub-lethal or chronic effects (*e.g.*, temperature effects on growth, disease, smoltification, and competition), but the resultant cumulative thermal exposure fish experience over the course of a week or more needs to be considered when selecting a 7DADM value to protect against these effects.

The diurnal variation in temperature of rivers and streams in the Pacific Northwest varies considerably; therefore, the difference between the 7DADM and the weekly mean will vary. The difference between the 7DADM temperature and the weekly mean may be less than 1°C for rivers with little diurnal variation and as high as 9°C for streams with high diurnal variation (Dunham *et al.* 2001). Another variable is food availability. Based on studies with fluctuating temperature regimes, fluctuating temperatures increase juvenile growth rates when the mean temperature is colder than the optimal growth temperature derived from constant temperature studies, but will reduce growth when the mean temperature exceeds the optimal growth temperature (McCullough *et al.* 2001). However, in situations where food is abundant, optimal growth temperatures would be higher. Thus, a particular 7DADM numeric criterion would be more protective in situations where food is abundant and will be less protective in situations where food is limited. NOAA Fisheries concludes that Oregon's metric for its temperature standard meets the biological requirements of listed Pacific salmon and steelhead.

<u>Numeric Criteria for Temperature</u>
Oregon's revised numeric criteria for temperature are consistent with those in the Temperature Guidance. Therefore, this analysis of effects is based on the scientific information and rationale developed for the Temperature Guidance, including the six technical issue papers (Dunham *et al.* 2001, Materna 2001, McCullough *et al.* 2001, Poole *et al.* 2001, Sauter *et al.* 2001, and Water Temperature Criteria Technical Workgroup 2001). The temperature ranges and associated effects from these issue papers are discussed in the following sections and are summarized in Table 2.

<u>Salmon and Steelhead Spawning through Fry Emergence – 13°C [OAR 340-041-0028(4)(a)]</u>
OAR 340-041-0028(4)(a) includes a 13°C, 7DADM criterion, which translates to an equivalent constant temperature of 11.5°C. This intent of this criterion is to protect spawning, egg incubation, and fry emergence for salmon and steelhead (*i.e.*, the beneficial uses). The criterion is identical to the criterion EPA recommended in the Temperature Guidance.

In its BE, EPA determined that the 13°C salmon and steelhead spawning through fry emergence criterion may affect, but is not likely to adversely affect the subject threatened and endangered species. Provided the criterion is applied in the times and places that the stated uses occur, this criterion is adequate to: (1) Protect gametes before spawning [less than 13°C, (constant)]; (2) provide temperatures at which spawning is most frequently observed in the field [4-14°C (daily average)]; and (3) provide protective temperatures for egg incubation [4-12°C (constant) for good survival and 6-10°C (constant) for optimal survival]. Therefore, based on the consistency of this criterion with the Temperature Guidance, NOAA Fisheries concurs with EPA's determination of effect. UCR spring chinook, UCR steelhead, and SR sockeye would not be affected by approval of the subject criterion because their spawning and rearing habitat is located outside of the action area.

<u>Core Cold Water Habitat – 16°C [OAR 340-041-0028(4)(b)]</u>
OAR 340-041-0028(4)(b) includes a 16°C, 7DADM criterion, which translates to an equivalent constant temperature of 14.5°C. The intent of this criterion is to protect salmon and steelhead

juvenile rearing, and salmon and steelhead adult holding before spawning. This criterion is identical to the criterion EPA recommended in the Temperature Guidance, and roughly translates to an equivalent constant temperature of 14.5°C.

In its BE, EPA determined that the 16°C core cold water habitat criterion may affect, but is not likely to adversely affect the subject threatened and endangered species. Provided the criterion is applied in the times and places that the stated uses occur, this criterion is adequate to: (1) Protect juvenile salmon and trout from lethal temperatures (23-26°C constant); (2) provide conditions during the period of summer maximum temperature at the upper end of the optimal temperature range when food is limited for juvenile growth (10-16°C constant), thus providing optimal temperatures for other times of the year; (3) minimize temperature-induced elevated disease rates (14-17°C constant); and (4) provide a thermal regime that supports juvenile salmon and steelhead populations, as demonstrated by studies indicating moderate-to-high fish densities in waters within this thermal range (10-17°C constant or less than 18°C, 7DADM). Therefore, based on the consistency of this criterion with the Temperature Guidance, NOAA Fisheries concurs with EPA's determination of effect. UCR spring chinook, UCR steelhead, and SR sockeye would not be affected by approval of the subject criterion because their spawning and rearing habitat is located outside of the action area.

<u>Salmon and Steelhead Juvenile Rearing and Migration – 18°C [OAR 041-0028(4)(c)]</u>
OAR 340-041-0028(4)(c) includes an 18°C, 7DADM criterion, which translates to an equivalent constant temperature of 16.5°C. The intent of this criterion is to protect waters with low-to-moderate densities of rearing and migrating salmon and steelhead. This criterion is identical to the criterion recommended in the Temperature Guidance.

In its BE, EPA determined that the 18°C salmon and steelhead rearing and migration criterion may affect, and is likely to adversely affect the subject threatened and endangered species. Provided the criterion is applied in the times and places that the stated uses occur, this criterion is adequate to: (1) Protect against lethal conditions for both juveniles and adults (21-22°C constant); (2) prevent migration blockage conditions for migrating adults (21-22°C average); (3) provide sub-optimal juvenile growth conditions (under limited food conditions) during the summer maximum conditions, and optimal conditions during non-summer months of the year (10-16°C constant); and (4) minimize exposure time of adult and juvenile salmon and steelhead to temperatures that can lead to high disease risk (18-20°C constant). However, at this temperature, which would occur during the summer maximum period, disease risk for adult and juvenile salmon and steelhead is elevated. Therefore NOAA Fisheries concurs with EPA's determination of effect due to the likelihood of localized elevation of disease risk for some adult and juvenile salmon and steelhead, reduced viability of gametes in some holding adults, and reduced growth of some juvenile salmon and steelhead. UCR spring chinook, UCR steelhead, and SR sockeye would not be affected by approval of the subject criterion because their spawning and rearing habitat is located outside of the action area.

Table 2. Summary of Temperature Considerations for Salmon and Steelhead Life Stages

Life Stage	Temperature Consideration	Temperature & Unit	Reference
Spawning and Egg Incubation	Temperature range at which spawning is most frequently observed in the field	4 - 14°C (daily avg.)	Issue Paper 1,[1] pp. 17-18
	Egg Incubation Studies - In good gravel - Optimal range	 4 - 12°C (constant) 6 - 1 °C (constant)	 Issue Paper 5,[2] p. 81
	Reduced viability of gametes in holding adults	13°C (constant)	Issue Paper 5, p. 16
Juvenile Rearing	Lethal temperature (1-week exposure)	23 - 26°C (constant)	Issue Paper 5, pp. 12, 14 (Table 4), 17, and 83-84
	Optimal growth - Unlimited food - Limited food	 13 - 20°C (constant) 10 - 16°C (constant)	 Issue Paper 5, pp. 3-6 (Table 1), and 38-56
	Rearing preference temperature in lab and field studies	10 - 17°C (constant) <18°C (7DADM)	Issue Paper 1, p. 4 (Table 2) Welsh *et al.* 2001
	Impairment to smoltification	12 - 15°C (constant)	Issue Paper 5, pp. 7 and 57-65
	Impairment to steelhead smoltification	>12°C (constant)	Issue Paper 5, pp. 7 and 57-65
	Disease risk (lab studies) - High - Elevated - Minimized	>18 - 20°C (constant) 14 - 17°C (constant) 12 - 13°C (constant)	Issue Paper 4,[3] pp. 12-23
Adult Migration	Lethal temperature (1-week exposure) Migration blockage and migration delay Disease risk (lab studies) - High - Elevated - Minimized Adult swimming performance - Reduced - Optimal Overall reduction in migration fitness due to cumulative stresses	21 - 22°C (constant) 21 - 22°C (average) >18 - 2°C (constant) 14 - 17°C (constant) 12 - 13°C (constant) >20°C (constant) 15 - 19°C (constant) >17 - 18°C (prolonged exposure)	Issue Paper 5, pp. 17, 83-87 Issue Paper 5, pp. 9, 10, 72-74 Issue Paper 1, pp. 15-16 Issue Paper 4, pp. 12 - 23 Issue Paper 5, pp. 8, 9, 13, 65 - 71 Issue Paper 5, p. 74

[1] Sauter, S.T., J. McMillan, and J. Dunham. 2001. Issue paper 1: salmonid behavior and water temperature. EPA-910-01-001. U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 36 p.

[2] McCullough, D.A., S. Spalding, D. Sturdevant, and M. Hicks. 2001. Issue paper 5: summary of technical literature examining the physiological effects of temperature on salmonids. EPA-910-D-01-005. U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 114 p.

[3] Materna, E. 2001. Issue paper 4: temperature interaction. EPA-910–D-01-004. U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 33 p.

Salmon and Steelhead Migration – 20°C and sufficiently distributed cold water refugia [041-0028(4)(d)]

OAR 340-041-0028(4)(d) includes a 20°C, 7DADM numeric criterion, plus a narrative provision that requires sufficiently distributed cold water refugia to protect waters designated for salmon and steelhead migration. This criterion translates to an equivalent constant temperature of about 19-20°C. The intent of this criterion is to protect migrating juveniles and adults from lethal temperatures and prevent migration blockage due to thermal conditions (Table 2).

The numeric and narrative provisions of this criterion are consistent with that recommended in the EPA Temperature Guidance. However, although the criterion is meant to be applied in areas that primarily serve as migration corridors (*i.e.*, not to areas with significant adult holding or juvenile rearing), sublethal adverse effects to listed adult and juvenile salmon and steelhead could occur at this temperature (Table 2) (Water Quality Criteria Technical Workgroup 2001). Therefore, to protect this use, the Temperature Guidance recommended that states or tribes supplement the numeric criterion of 20°C with a "narrative provision that would require the protection, and where feasible, the restoration of the natural thermal regime."

According to the Temperature Guidance, critical aspects of the natural thermal regime that should be protected and restored include "the spatial extent of cold water refugia (generally defined as waters that are 2°C colder than the surrounding water), the diurnal temperature variation, the seasonal temperature variation (*i.e.*, number of days at or near the maximum temperature), and shifts in the annual temperature pattern." These habitat attributes, which make it possible for migrating fish to seek thermal refuge from adverse water temperatures, are less available in modern-day rivers where hydrologic functions such as floodplain connectivity and groundwater inflow have been significantly diminished (Poole and Berman 2001, Poole *et al.* 2001).

Well-distributed cold water refugia are defined in Oregon's rule as "those portions of a waterbody where, or times during the diel temperature cycle when, the water temperature is at least 2°C colder than the daily maximum temperature of the adjacent well mixed flow of the waterbody." ODEQ's narrative provision states that "In addition, these waterbodies must have cold water refugia that is sufficiently distributed so as to allow salmon and steelhead migration without significant adverse effects from higher water temperatures elsewhere in the waterbody. Finally, the seasonal thermal pattern in Columbia and Snake Rivers must reflect the natural seasonal thermal pattern."

According to the BE, the narrative provision is likely to be implemented during establishment of TMDLs, because all the waters for which ODEQ is proposing for this use currently do not attain 20°C, thus a TMDL is required based on the numeric criteria. ODEQ's narrative provision is generally consistent with the EPA Temperature Guidance, in that it considers spatial and temporal aspects of water temperature cycles and cold water refugia, and seasonal temperature variation in the Columbia and mainstem Snake Rivers. ODEQ's narrative adds a protective performance measure of requiring salmon and steelhead migration without significant adverse effects from higher water temperatures elsewhere in the waterbody.

NOAA Fisheries has determined that potential adverse effects of this criterion would not be of a magnitude, extent or duration that would pose significant risks to the long-term survival of the listed ESUs, because of the following six factors:

1. The limited geographical application of the criterion (discussed in the analysis of the beneficial use designations for salmon and steelhead migration corridors below).

2. The absence or limited abundance of rearing juvenile fish at the times and places the provision would apply.

3. The cold water refugia provision that should provide areas of colder water.

4. Consideration of spatial and temporal aspects of water temperature cycles and cold water refugia.

5. A narrative performance measure in the criterion requiring salmon and steelhead migration without significant adverse effects from higher water temperatures elsewhere in the waterbody.

6. The requirement that the seasonal thermal pattern in the Columbia and Snake Rivers must reflect the natural seasonal thermal pattern.

In its BE, EPA determined that the subject criterion is likely to adversely affect the subject threatened and endangered species. Based on the consistency of this criterion with the Temperature Guidance, NOAA Fisheries concurs with EPA's determination.

2.1.5.1.5 EPA's Proposed Approval of Oregon's Salmonid Use Designations OAR 340-041-0101 to OAR 340-041-0340

Beneficial use designations define when and where beneficial uses (*e.g.*, salmon and steelhead spawning) occur. Beneficial use designations are part of Oregon's water quality standards, as required by the CWA, and the fish use designations shown on the maps and tables (BE, Appendices B, C, and D) are proposed to be adopted into the Oregon Administrative Rules by reference. Most of Oregon's basins have two maps to represent fish uses, one for uses that occur throughout the year, including the warmest period (July and August), and a second for salmon and steelhead spawning use (spawning through fry emergence). Water quality criteria apply for the uses shown on the fish use designation maps year-round, except when a more stringent spawning criterion applies. The spawning criteria apply to the reaches and date ranges shown on the salmon and steelhead spawning use designation maps. In many cases, more than one fish use occurs in the same waterbody. In this case, the use designation was based on the most sensitive species or life stage. Oregon has provided maps and tables to display when and where salmonid uses occur in each of their 20 basins (BE, Appendices B, C, D, and E). The fish use designation maps and tables may be viewed on the ODEQ web site at:
http://www.deq.state.or.us/wq/standards/WQStdsTemp.htm

ODEQ worked together with an interagency team [EPA, NOAA Fisheries, the U.S. Fish and Wildlife Service, and the Oregon Department of Fish and Wildlife (ODFW)] to designate fish uses. ODEQ primarily relied on ODFW for information on fish distribution and life stage timing. This information can be viewed on the internet at: http://rainbow.dfw.state.or.us/nrimp/information/index.htm

The ODFW methodology for developing their database is described in the procedures manual for the 1:24K fish habitat distribution development project (ODFW 2002). The database was the product of a multi-year effort by ODFW to develop consistent and comprehensive fish distribution data for a number of salmonid species. This database includes all basins or sub-basins in Oregon that have anadromous fish. The distribution data represent known fish use based on documented observations, as well as the best professional judgment of local field biologists as to where use is likely to occur based on suitable habitat (*i.e.*, waters near areas of documented life stage presence on the same waterbody that have similar habitat features, such as flow volume, gradient, gravel size, and pool frequency, and no known obstructions or reasons why the use would not also be present in these waters).

ODFW compiled and reviewed fish distribution information from a variety of sources, including state and Federal fisheries agencies, Federal land management agencies, tribal entities, watershed councils, and other interested public or private organizations. The ODFW fish distribution data reflect areas of fish use based on information collected over the past five life cycles for a particular species, which ranges from 15 to 35 years. In addition to spatial fish distribution data that describe where a life stage use is known or likely to occur, the ODFW database also includes information describing when a life stage use is known or likely to occur based on locations near areas with documented life stage presence and suitable habitat. ODEQ also used unpublished data on juvenile salmonid abundance that was used for Ecotrust *et al.* (2000), and unpublished data on juvenile salmonid abundance that was used for Dewberry (2003).

The ODFW database and the Ecotrust data are the best available, scientifically sound, fish distribution information sources with which to base salmonid use designations. The databases reflect a conservative approach in that they are based on fish presence information spanning multiple years and included waters where fish are likely to occur. This approach is appropriate because salmonid use designations based solely on areas of documented presence does not sufficiently describe the actual waters of use due to the practical limitations of monitoring every stream mile, and routine fish monitoring sometimes indicates no fish presence when fish are actually present (*i.e.*, false negatives), and because fish distributions vary from year-to-year for any given waterbody (Dunham *et al.* 2001).

2.1.5.1.5.1 OAR 340-041-0028(4) Biologically-Based Numeric Criteria

Unless superseded by the natural conditions criteria described in section (8) of the Oregon rule, or by subsequently adopted site-specific criteria approved by EPA, the following temperature criteria apply for state waters supporting salmonid fishes. EPA proposes to approve these criteria (emphasis added):

> OAR 340-041-0028(4)(a)
> The seven-day average maximum temperature of a stream identified as having **salmon and steelhead spawning use** on subbasin maps and tables set out in OAR 340-041-0101 to OAR 340-041-0340: Tables 101B, and 121B, and Figures 130B, 151B, 160B, 170B, 220B, 230B, 271B, 286B, 300B, 310B, 320B, and 340B, may not exceed 13.0 degrees Celsius at the times indicated on these maps and tables.
>
> OAR 340-041-0028(4)(b)
> The seven-day average maximum temperature of a stream identified as having **core cold water habitat use** on subbasin maps set out in OAR 340-041-101 to OAR 340-041-340: Figures 130A, 151A, 160A, 170A, 220A, 230A, 271A, 286A, 300A, 310A, 320A, and 340A, may not exceed 16.0 degrees Celsius (60.8 degrees Fahrenheit).
>
> OAR 340-041-0028(4)(c)
> The seven-day-average maximum temperature of a stream identified as having **salmon and trout rearing and migration use** on subbasin maps set out at OAR 340-041-0101 to OAR 340-041-0340: Figures 130A, 151A, 160A, 170A, 220A, 230A, 271A, 286A, 300A, 310A, 320A, and 340A, may not exceed 18 degrees Celsius.
>
> OAR 340-041-0028(4)(d)
> The seven-day-average maximum temperature of a stream identified as having a **migration corridor use** on subbasin maps and tables OAR 340-041-0101 to OAR 340-041-0340: Tables 101B, and 121B, and Figures 151A, 170A, and 340A, may not exceed 20.0 degrees Celsius. In addition, these waterbodies must have cold water refugia that are sufficiently distributed so as to allow salmon and steelhead migration without significant adverse effects from higher water temperatures elsewhere in the waterbody. Finally, the seasonal thermal pattern in Columbia and Snake Rivers must reflect the natural seasonal thermal pattern.

ODEQ did not identify in (4)(d) Figure 300A, Coos River, which has three small reaches designated for the migration corridor use.

Salmon and Steelhead Spawning through Fry Emergence Use OAR 340-041-0028(4)(a)

EPA proposes to approve the salmon and steelhead spawning through fry emergence use, which applies the 13°C criterion. The intent of this use is to protect the spatial extent of spawning, egg incubation, and fry emergence of salmon and steelhead, which is consistent with the Temperature Guidance.

The interagency team considered identifying each different combination of species locations and time periods where the ODFW database shows salmon or steelhead spawning through emergence occurs. However, this resulted in over 30 different spawning date ranges for just one basin. Because this approach seemed overly complicated and difficult to implement, the interagency team considered ways to simplify the method for designating spawning use time periods while still protecting this use. After reviewing the timing information for all salmon and steelhead, the interagency team agreed on the approach described below.[4]

1. In waters designated for salmon and trout rearing use during the summer months:
   a. Spawning through emergence use applies from October 15 through May 15 in reaches with fall spawners (chinook, coho or chum salmon), or a combination of fall and spring (steelhead) spawners.
   b. Spawning through emergence use applies from January 1 to May 15 in reaches that have only steelhead spawning.

2. In waters designated as core cold water habitats, spawning may begin earlier and/or emergence may end later. The above spawning through emergence dates apply unless they are extended as follows:
   a. Spawning use for chinook salmon begins two weeks after the earliest spawning date in the timing unit for that species according to the ODFW timing tables, but no later than October 15. If the initial spawning date is identified as peak use, there is no two-week delay.
   b. Emergence use for steelhead spawning reaches ends June 15.

3. In waters designated as migration corridors, use the best available site-specific information to determine dates of spawning use. This occurs in only two locations.
   a. In the Columbia River mainstem, chum salmon spawning use dates are based on site-specific information from ODFW.
   b. In the Snake River mainstem below Hell's Canyon dam, fall chinook spawning use dates are based on site specific information assembled during the development of the temperature TMDL.

The rationale for the two-week delay after the spawning start date in 2.a, above, is that the date shown in the ODFW timing tables applies to a timing unit, which in many cases includes several watersheds. The spawning criterion would apply throughout the designated reach the date this use begins, yet it is likely that the earliest spawning begins in cooler upstream tributaries. Also, the first two weeks of spawning was often identified as a period of lesser use (0 to 30%) of the life stage by ODFW, meaning fish are beginning to spawn at this time, but the majority (peak) of the populations spawn during the peak use period time (70 to 100%).

The later emergence end data for steelhead in 2.b, above, is used because in these colder waters, steelhead spawning and emergence typically occurs later. Although steelhead fry may emerge

---

[4] Discussion of the decision rules are provided under each use designation below.

even later than June 15 in some waters, those waters are typically a colder upstream (*i.e.*, high elevation) portion of where this use is designated. To attain the spawning criterion (*i.e.*, 13°C) on June 15 in the downstream extent of spawning reaches, temperatures would need to be colder in the upstream waters and therefore would likely not reach 13°C until later in the summer period.

The reasons for using site specific timing information for spawning through emergence in the migration corridors, as described in 3, above, are that the number of spawning reaches in these larger mainstem rivers are limited, the reaches are shorter segments, each reach has spawning by only a single species, and there is more site specific timing information available.

In its BE, EPA determined that the salmon and steelhead spawning through fry emergence use criterion may affect, but is not likely to adversely affect the subject threatened and endangered species. Based on the consistency of this criterion with the Temperature Guidance, and the use of the decision rules developed by the interagency team, NOAA Fisheries concurs with EPA's effects determination. UCR spring chinook, UCR steelhead, and SR sockeye would not be affected by approval of the subject criterion because their spawning and rearing habitat is located outside of the action area.

ODEQ considered and then declined to make beneficial use designation for salmon and steelhead smoltification. Smoltification occurs in the spring as these fish migrate to the ocean and go through the adaptation process for saltwater. Steelhead are believed to be the most temperature-sensitive salmonids during smoltification, which is why EPA recommended a separate designated use and criterion of 14°C in its Temperature Guidance. Generally, the interagency team believed that Oregon's water quality criterion (13°C for spawning through fry emergence) for temperature and associated designated uses would effectively protect steelhead smoltification. A possible exception was the John Day River basin, the only river (other than the lower Snake and Columbia Rivers) in which a significant portion of the river likely supports smoltification, was designated as 20°C during the summer maximum period.

The interagency team reasoned that since headwaters in the John Day River that the mouths of the tributaries in the lower reaches of the John Day River would be designated as 13°C through May 15 and, the mouth of the John Day River would be designated as 20°C for the summer maximum period, then the above downstream limits of these designations would need to be cooler. It is not known with certainty when steelhead smolt in this river, but it is likely that they would have left the river by May or June, and therefore steelhead likely would be exposed to waters below or slightly above 14°C waters during smoltification.

<u>Core Cold Water Habitat Use OAR 340-041-0028(4)(b)</u>

EPA proposes to approve the core cold water habitat use, which applies the 16°C criterion. The intent of this use is to provide optimal or near-optimal conditions for rearing of juvenile salmon and steelhead. In addition, these areas would provide colder holding waters for pre-spawning adults. These intentions are consistent with the recommendation for the subject uses in the EPA Temperature Guidance. The interagency team used the following indicators to identify where this use would apply: (1) Waters with spawning habitat for spring chinook spawn during the late summer months (August 1 through September 15); (2) waters identified as "anchor habitats" in Ecotrust *et al.* (2000) and Dewberry (2003) for listed salmon or trout;[5] (3) waters upstream of the areas identified in (1) and (2), above, that also support salmon and steelhead rearing, or provide cold water to these areas; and (4) waters where water temperature data that meets ODEQ's data quality requirements indicate that current stream temperature for the warmest week of the year are below 16°C (7DADM).

This use applies during the warmest times of the summer, the warmest years (except for unusual warm conditions as per OAR 340-041-0028(12(c)), and throughout the waterbody, including the lowest downstream extent of the waterbody designated for this use, which means the 7DADM temperatures likely would be cooler than 16°C most of the time where this use occurs. There are several reasons why the extent of waters meeting this criterion likely would be larger than those indicated on the beneficial use maps, and why these waters would be cooler than the criterion for most of the year: (1) The criterion must be attained at the furthest point downstream where this use is designated; (2) if the criterion is met during the summer maximum period, then temperatures would be colder during the rest of the year; and (3) the criterion must be met in the warmest years [except for unusual warm conditions as per OAR 340-041-0028(12 (c)].

Based on the decision rules developed by the interagency team, the core cold water habitat use initially was not designated in several of the ODEQ coastal subbasins, or in several Interior Columbia River/Snake River subbasins and watersheds. In its comments on the proposed ODEQ rule, October 2, 2003, letter from NOAA Fisheries to ODEQ, NOAA Fisheries noted that salmon and steelhead stocks in many of these subbasins and watersheds may constitute distinct populations within listed ESUs, based on preliminary work by NOAA Fisheries' technical recovery teams. Subsequent collection and analysis of existing temperature monitoring data by NOAA Fisheries and ODEQ identified some waters currently meeting this criterion, resulting in designation of some additional reaches for this use, but the reaches were mainly outside of the subject subbasins and watersheds.

Even though in an ideal situation some waters would be designated for the core cold water habitat use for each distinct population, NOAA Fisheries was not able to identify a compelling rationale to advocate additional designation of this use in the subject subbasins and watersheds. Although the existing data used to designate the core cold water habitat use represents the best available scientific information, uncertainties remain concerning the sufficiency of the use designation for certain distinct populations. However, although these uncertainties may increase the risk of adverse effects in these populations, NOAA Fisheries determined that potential adverse effects

[5] Ecotrust collected data on densities of juvenile salmon and steelhead to identify areas of high rearing use or key habitat features (anchor habitats) for coho salmon, chinook salmon, and steelhead trout in certain Oregon coastal basins. This information was peer-reviewed. ODEQ designated stream segments as core cold-water habitat in the North Coast Basin (an upper portion of the Necanicum River, Ecola Creek and Plympton Creek) and in the Mid Coast Basin (portions of the Siuslaw River) based on this data.

would not be of a magnitude, extent or duration that would pose significant risks to the long-term survival of the listed ESUs, based the net effect of six factors:

1. EPA and NOAA Fisheries compared the beneficial use maps with ESU maps and concluded that there were multiple areas that would be designated as core cold water habitat within each ESU.

2. Most of the subbasins and watersheds without the core cold water habitat use designated consist of either relatively low-elevation, dry-climate streams, or contain relatively short streams lacking high-elevation reaches, or are in southwest Oregon, so the subject streams likely are warmer under natural conditions than streams in other areas supporting salmon and steelhead. There is no reason to designate waters at a temperature that could not be attained even under natural conditions.

3. Although some areas that currently could meet the criterion may not have been designated due to a lack of water temperature data for those areas, Oregon's rules at 340-041-0028 (11) require the protection of existing cold water.

4. Oregon's rules at 340-041-0004 require an in-depth antidegradation review before ODEQ permits any lowering of water quality in waters that meet the temperature criteria.
5. In all of the 14 temperature-related TMDLs completed by ODEQ to date, all of the non-point heat sources in the subject river basins have been given zero allocations of heat, meaning that in general, stream thermal potential basically would be achieved upon attainment of the TMDL allocations.[6]

6. The additional monitoring (CM 1) proposed by EPA of priority basins with few or no waters designated for the core cold water habitat use and with distinct populations of listed salmon and steelhead represents a means to acquire additional scientific data to reduce uncertainty about the distribution of waters currently meeting the subject criterion.

In its BE, EPA determined that the designation of the beneficial use for core cold water habitat may affect, but is not likely to adversely affect, the subject threatened and endangered species. Based on the general consistency of this criterion with the Temperature Guidance, and the above analysis, NOAA Fisheries concurs with EPA's determination for nine of the 14 ESUs subject to this consultation. However, NOAA Fisheries does not concur with EPA's determination for OC and SONC coho salmon, or for MCR, LCR, and SR steelhead due to the likelihood of localized elevated disease risk for some adults and juveniles, reduced viability of gametes in some holding adults (LCR, MCR, and SR steelhead only), and reduced growth of some juveniles resulting from

---

[6] A lack of regulatory authority in ODEQ to require natural stream flows may impede attainment of full natural thermal potential. Also, current rules designate the Oregon forest practice rules as the compliance mechanism for forestry and Senate Bill 1010 plans as the compliance mechanism for agriculture. Changes likely would need to be made to forestry and agricultural practices in order for TMDL allocations to be attained in many waterways. Such changes involve rule implementation issues beyond the CWA discretion of EPA.

the possible under-designation of the subject use. UCR spring chinook, UCR steelhead, and SR sockeye would not be affected by approval of the subject beneficial use because their spawning and rearing habitat is located outside of the action area.

Salmon and Trout (steelhead) Juvenile Rearing and Migration Use OAR 340-041-0028(4)(c)

EPA proposes to approve the salmon and trout (steelhead) juvenile rearing and migration use, which applies the 18°C criterion. This intent of this use is to protect migration habitat of adult and juvenile salmon and steelhead, and moderate-to-low density rearing habitat for salmon and steelhead, during the period of summer maximum temperatures. This intention is consistent with the recommendation for the subject uses in the EPA Temperature Guidance. The interagency team used the following indicators to identify where this use would apply: (1) Waters that would provide rearing habitat for salmon or steelhead in July or August; (2) waters that would provide rearing habitat for rainbow or coastal cutthroat trout; and (3) all waters upstream of the waters identified in (1) and (2), above.

In waters designated under the 18°C criterion, sublethal adverse effects are possible for holding adults and rearing juveniles (Table 2, and Water Quality Technical Workgroup 2001). The interagency team used the best available scientific information in recommending designation of this beneficial use. However, due to the use of fish habitat distribution to designate this use, as opposed to the use of modeled thermal potential supplemented with other lines of evidence such as fish distribution, the beneficial use designations in this category could correspond to water temperatures that are warmer than natural conditions in a limited number of times and places. Adverse effects in waters meeting the 18°C criterion would be attributable to the proposed action by EPA only where natural conditions would be capable of producing colder water than were designated under this use.

On the other hand, it is likely a portion of the waters designated for this use would be cooler than indicated on the beneficial use maps, and these waters would be cooler than the criterion for most of the year due to the following reasons: (1) The criterion must be attained at the furthest point downstream where this use is designated; (2) if the criterion is met during the summer maximum period, then temperatures would be colder during the rest of the year; and (3) the criterion must be met in the warmest years [except for unusual warm conditions as per OAR 340-041-0028(12(c)]. Once ODEQ completes a temperature TMDL in a basin designated for this use, the extent of any over-designation of this use should become apparent. And, in all of the 14 temperature-related TMDLs completed by ODEQ to date, all of the non-point heat sources in the subject river basins have been given zero allocations of heat, meaning that in general, stream thermal potential basically would be achieved upon attainment of the TMDL allocations.[7]

[7] A lack of regulatory authority in ODEQ to require natural stream flows may impede attainment of full natural thermal potential. Also, current rules designate the Oregon forest practice rules as the compliance mechanism for forestry and Senate Bill 1010 plans as the compliance mechanism for agriculture. Changes likely would need to be made to forestry and agricultural practices in order for TMDL allocations to be attained in many waterways. Such changes involve rule implementation issues beyond the CWA discretion of EPA.

In its BE, EPA determined that the designation of the beneficial use for the salmon and trout (steelhead) juvenile rearing and migration use may affect, but is not likely to adversely affect, the subject threatened and endangered species. Based on the general consistency of this criterion with the Temperature Guidance and the above analysis, NOAA Fisheries concurs with EPA's determination for nine of the 14 ESUs subject to this consultation. However, NOAA Fisheries does not concur with EPA's determination for OC and SONC coho salmon, or for MCR, LCR, and SR steelhead due to the likelihood of localized elevated disease risk for some adults and juveniles, reduced viability of gametes in some holding adults (LCR, MCR, and SR steelhead only), and reduced growth of some juveniles resulting from the possible over-designation of the subject use. UCR spring chinook, UCR steelhead, and SR sockeye would not be affected by approval of the subject beneficial use because their spawning and rearing habitat is located outside of the action area.

Salmon and Steelhead Migration Corridors Use OAR 340-041-0028(4)(d)

EPA proposes to approve the salmon and steelhead migration corridors use, which applies the 20°C criterion including its narrative provision regarding cold water refugia. This intent of this use is to protect migrating juveniles and adults from lethal temperatures and migration blockage due to thermal conditions. The interagency team applied this use to areas where the ODFW distribution and timing information indicates that there is migration habitat but no verifiable rearing use in July and August, or that a lower mainstem river is primarily a migration corridor during the period of summer maximum temperatures. Also, this use was applied only if there was evidence to suggest that temperatures would have reached 20°C under the natural thermal regime. Based on this approach, ODEQ designated this use for the following reaches: (1) The lower Willamette River (from the mouth to river mile 50), (2) the lower John Day River (from the mouth to the confluence with the North Fork John Day River), (3) the Columbia River mainstem from the mouth to the Washington-Oregon border, (4) the Snake River from the Washington-Oregon border to Hells Canyon Dam (5) lower Little Creek and Catherine Creek in the Grand Ronde River basin, and (6) three short reaches of the lower Coos River.

In waters designated under the 20°C criterion, sublethal adverse effects are possible for holding adults and rearing juveniles (Table 2) (WTCTW 2001). This is particularly true in rivers in which fish are present throughout the summer maximum period, including the Willamette, Columbia and Snake Rivers. The interagency team used the best available scientific information in recommending designation of this beneficial use. However, due to the use of fish habitat distribution to designate this use in some rivers, as opposed to the use of modeled thermal potential supplemented with other lines of evidence such as fish distribution, the beneficial use designations in this category could correspond to water temperatures that are warmer than natural conditions in certain times and places outside of the mainstem Columbia and Snake Rivers[8]. Adverse effects in waters meeting the 20°C criterion would be attributable to the proposed action

[8] Information considered by the interagency team indicated that the 20°C use was appropriate for the mainstem Columbia and Snake Rivers based on current understanding of the natural thermal regime for those rivers.

by EPA only where natural conditions would be capable of producing colder water than were designated under this use.

There are several reasons why a portion of the waters designated for this use would be cooler than indicated on the beneficial use maps, and why these waters would be cooler than the criterion for most of the year: (1) The criterion must be attained at the furthest point downstream where this use is designated; (2) if the criterion is met during the summer maximum period, then temperatures would be colder during the rest of the year; and (3) the criterion must be met in the warmest years [except for unusual warm conditions as per OAR 340-041-0028(12(c)]. Once ODEQ completes a temperature TMDL in a watershed designated for this use, the extent of any over-designation of this use should become apparent. And, in all of the 14 temperature-related TMDLs completed by ODEQ to date, all of the non-point heat sources in the subject river basins have been given zero allocations of heat, meaning that in general, stream thermal potential basically would be achieved upon attainment of the TMDL allocations.[9]

In its BE, EPA determined that the designation of the beneficial use for salmon and steelhead migration corridors is likely to adversely affect the subject threatened and endangered species. Based on the above analysis, NOAA Fisheries concurs with EPA's determination of effect for UWR chinook, SR spring/summer chinook, and for UWR, MCR, and SR steelhead due to the likelihood of localized elevated disease risk for some adults, and reduced viability of gametes in some holding adults from the possible over-designation of the subject use. The other species covered by this consultation either do not occur where this use is designated, or occur in areas where information considered by the interagency team indicated the use was appropriate based on current understanding of the natural thermal regime (*e.g.*, mainstem Columbia and Snake Rivers).

2.1.5.1.6 Narrative Temperature Criteria and Implementation Provisions and State Wide Narrative Criteria

These intent of these criteria is to protect all salmon and steelhead life stages. OAR 340-041-0028(8) and OAR 340-041-0007(2) include the following provisions that EPA proposes to approve:

> OAR 340-041-0028(8) Natural Conditions Criteria. Where the department determines that the natural thermal potential of all or a portion of a waterbody exceeds the biologically-based criteria in section (4) of this rule, the natural thermal potential temperatures supersede the biologically-based criteria, and are deemed to be the applicable temperature criteria for that waterbody."

---

[9] A lack of regulatory authority in ODEQ to require natural stream flows may impede attainment of full natural thermal potential. Also, current rules designate the Oregon forest practice rules as the compliance mechanism for forestry and Senate Bill 1010 plans as the compliance mechanism for agriculture. Changes likely would need to be made to forestry and agricultural practices in order for TMDL allocations to be attained in many waterways. Such changes involve rule implementation issues beyond the CWA discretion of EPA.

> OAR 340-041-0002(34) Natural Conditions. Natural conditions means conditions or circumstances affecting the physical, chemical, or biological integrity of a water of the State that are not influenced by past or present anthropogenic activities. Disturbances from wildfire, floods, earthquakes, volcanic or geothermal activity, wind, insect infestation, diseased vegetation are considered natural conditions.
>
> OAR 340-041-0002(35) Natural Thermal Potential. Natural thermal potential means the determination of the thermal profile of a waterbody using best available methods of analysis and the best available information on the site potential riparian vegetation, stream geomorphology, stream flows and other measures to reflect natural conditions."
>
> OAR 340-041-0007(2) State Wide Narrative Criteria. Where a less stringent natural condition of a water of the state exceeds the numeric criteria set out in this division, the natural condition supersedes the numeric criteria and becomes the standard for that waterbody. However, there are special restrictions, described in OAR 340-041-0004(9)(a)(C)(iii), that may apply to discharges that affect dissolved oxygen. State wide narrative criteria also includes OAR 340-041-0002(34).

The Temperature Guidance recommends "natural conditions"criteria fully support salmonids by reflecting conditions absent human impacts, and that the criteria not allow temperature changes due to past human activities to be considered as part of the natural condition. The Temperature Guidance includes what EPA and NOAA Fisheries consider to be the best available methods to estimate the natural conditions for temperature.

ODEQ has described methods it may use to determine natural conditions for temperature in the December 19, 2003, letter to Randy Smith, EPA from Mike Llewellyn, ODEQ dated (BE Appendix G). Depending upon the specific situation, ODEQ may use different methods for determining natural conditions; however, the methods described to date are consistent with the recommendations in the Temperature Guidance. Conservation measure 3 offers an additional opportunity to confirm that ODEQ is implementing the natural background provisions in a manner that is consistent with the scope of the analysis of effects and conclusion described in this Opinion.

In its BE, EPA determined that the natural condition and state wide narrative criteria may affect, but is not likely to adversely affect, the subject threatened and endangered species. Based on the above consistency of this criterion with the Temperature Guidance, and CM 3, NOAA Fisheries concurs with EPA's determination of effect.

Protecting Cold Water

The intent of this criterion is to protect existing waters that are colder than the biologically-based numeric criteria, and to protect all salmon and steelhead life stages. OAR 340-041-0028(11) includes the following provisions that EPA proposes to approve:

(a) Except as described in subsection (c) of [the Oregon] rule, waters of the state that have summer 7DADM ambient temperatures that are colder than the biologically-based criteria in section (4) of the Oregon rule, may not be warmed by more than 0.3°C above the colder water ambient temperature. This provision applies to all sources taken together at the point of maximum impact where salmon or steelhead are present.

(b) A point source that discharges into or above salmon and/or steelhead spawning waters that are colder than the spawning criterion, may not cause the water temperature in the spawning reach where the physical habitat for spawning exists during the time spawning through emergence use occurs, to increase more than the following amounts after complete mixing of the effluent with the river:

(A) If the rolling 60-day average maximum ambient water temperature, between the dates of spawning use as designated under subsection (4)(a) of this rule, is 10 to 12.8°C, the allowable increase is 0.5°C above the 60-day average; or (B) if the rolling 60-day average maximum ambient water temperature, between the dates of spawning use as designated under subsection (4)(a) of this rule, is less than 10°C, the allowable increase is 1.0°C above the 60-day average, unless the source provides analysis showing that a greater increase will not significantly affect the survival of salmon or steelhead eggs or the timing of salmon or steelhead fry emergence from the gravels in downstream spawning reach.

(c) The cold water protection narrative criterion in subsection (a) does not apply if:

(A) There are no threatened or endangered salmonids currently inhabiting the waterbody,

(B) The waterbody has not been designated as critical habitat, and

(C) The colder water is not necessary to ensure that downstream temperatures achieve and maintain compliance with the applicable temperature criteria.

In its BE, EPA determined that the provisions for protecting cold water may affect, but are not likely to adversely affect the subject threatened and endangered species. In waters where listed salmon or steelhead occur, or where critical habitat has been designated, Oregon’s cold water protection provisions are likely to prevent summer temperature increases of more than 0.3°C above the colder water ambient temperature, considering all sources together at the point of maximum impact, which EPA considers to be an insignificant increase (BE, p. 5-31). The 0.3°C maximum increase is consistent with the allowance for human use in the Temperature Guidance. The provisions also minimize temperature increases at other times of the year, although the provisions do not specify that they apply to all sources taken together at the point of maximum impact. According to ODEQ, this is not needed because non-point source heat discharges are minimal during the colder months, and ODEQ does not know of circumstances where there are overlapping temperature mixing zones. Based on this information, NOAA Fisheries concurs with EPA's determination of effect.

ODEQ has not described the methods it will use to track cumulative thermal increases or determine the “point of maximum increase.” The 2-year review represents an opportunity to confirm that ODEQ is implementing and tracking its heat load limits in a manner that is consistent with the scope of the analysis of effects and conclusion described in this Opinion.

Human Use Allowance

The intent of this provision is to permit additional heat into a stream or river from human activities when the natural conditions criterion is the applicable criterion or where waters are currently exceeding the biologically-based numeric criteria. OAR 340-041-0028(12)(b) includes the following provisions that EPA proposes to approve:

> OAR 340-041-0028(12)(b) Human Use Allowance. Insignificant additions of heat are authorized in waters that exceed the applicable temperature criteria as follows:
>
> (A) Before the completion of a temperature TMDL, or other cumulative effects analysis, no single NPDES point source that discharges into a temperature water quality limited water may cause the temperature of the waterbody to increase more than 0.3°C above the applicable criteria after mixing with either 25% of the stream flow, or the temperature mixing zone, whichever is more restrictive; or
>
> (B) Following a temperature TMDL, or other cumulative effects analysis, waste load and load allocations will restrict all NPDES point sources and nonpoint sources to a cumulative increase of no greater than 0.3°C above the applicable criteria after complete mixing in the waterbody, and at the point of maximum impact.
>
> (C) Point sources must be in compliance with the additional mixing zone requirements set out in OAR 340-041-0053(2)(d).

An allowance for human use above the applicable criterion is consistent with EPA's Temperature Guidance. Without such a provision, no heat would be permitted from human activities when the natural conditions criterion is the applicable criterion, and NPDES permits in temperature impaired waters likely would have effluent limits with end-of-pipe numeric criteria.

ODEQ does not know of circumstances where there are overlapping mixing zones that may lead to cumulative thermal increases above 0.3°C. In its BE, EPA determined that a temperature increase of 0.3°C or less is insignificant; however, EPA determined that the subject criterion is likely to adversely affect the subject threatened and endangered species. NOAA Fisheries concurs with EPA's effect determination due to the likelihood of elevated disease risk for some adult and juvenile salmon and steelhead, and slightly reduced growth and survival of some juvenile salmon and steelhead, particularly within temperature mixing zones. However, these adverse effects will be minimized due to the application of thermal plume provisions (discussed below).

The ODEQ rule requires that upon completion of a TMDL, the maximum allowable temperature increase for all sources cumulatively would be no more than 0.3°C above the applicable criteria. ODEQ has not described the methods it will use to track cumulative thermal increases. The 2-year review represents an opportunity to confirm that ODEQ is implementing and tracking its heat load limits in a manner that is consistent with the scope of the analysis of effects and conclusion described in this Opinion.

Air Temperature Exclusion

OAR 340-041-0028(12)(c) includes the following provision that EPA proposes to approve:

> OAR 340-041-0028(12)(c) Air Temperature Exclusion. "A waterbody that only exceeds the criteria set out in this rule when the exceedance is attributed to daily maximum air temperatures that exceed the 90th percentile value of annual maximum 7DADM air temperatures calculated using at least 10 years of air temperature data, would not be listed on the section 303(d) list of impaired waters and sources will not be considered in violation of this rule."

In its BE, EPA determined that the air temperature exclusion provision may affect, but is not likely to adversely affect the subject threatened and endangered species. Based on the consistency of this provision with the Temperature Guidance, NOAA Fisheries concurs with EPA's determination of effect.

Temperature Thermal Plume Limitations

The intent of this provision is to protect salmon and steelhead from point source discharges. OAR 340-041-0053(2)(d) includes the following provisions that EPA proposes to approve:

> OAR 340-041-0053(2)(d) Temperature Thermal Plume Limitations. "Temperature mixing zones and effluent limits authorized under 340-041-0028(12)(b) would be established to minimize the following adverse effects to salmonids inside the mixing zone:
>
> (A) Impairment of an active salmonid spawning area where spawning redds are located or likely to be located. This adverse effect is prevented or minimized by limiting potential fish exposure to temperatures of 13°C or less for salmon and steelhead;
>
> (B) Acute impairment or instantaneous lethality is prevented or minimized by limiting potential fish exposure to temperatures of 32.0°C or more to less than two seconds);
>
> (C) Thermal shock caused by a sudden increase in water temperature is prevented or minimized by limiting potential fish exposure to temperatures of 25.0°C or more

to less than 5% of the cross section of 100% of the 7Q10 low flow of the waterbody; The Department may develop additional exposure timing restrictions to prevent thermal shock; and

(D) Unless the ambient temperature is 21.0 degrees of greater, migration blockage is prevented or minimized by limiting potential fish exposure to temperatures of 21.0°C or more to less than 25% of the cross-sectional area of 100% of the 7Q10 low flow of the waterbody."

The above provisions are consistent with the Temperature Guidance.

Acute thermal shock leading to death can be induced by rapid shifts in temperature (McCullough 1999). The effect of the shock depends on acclimation temperature, the magnitude of the temperature shift, and exposure time (Tang *et al.* 1987, as cited in McCullough 1999). Thermal shock can also indirectly increase mortality. Juvenile chinook salmon and rainbow trout acclimated to 15 to 16° C and transferred to temperature baths in the range of 26 to 30° C (cooler than temperature of the Blue Heron discharge) suffered significantly greater predation than controls (Coutant 1973). Coho salmon and steelhead trout acclimated to 10° C and transferred to 20° C water suffered sublethal physiological changes including hyperglycemia, hypocholestorolemia, increased blood hemoglobin, and decreased blood sugar regulatory precision (Wedemeyer 1973). Based on this information, sublethal adverse effects from shifts of 10° C shock are possible at end temperatures cooler than 25.0°C. Provision (C) above therefore limits thermal shock to that which occurs in 5% of the cross section of 100% of the 7Q10 low flow of the waterbody, which is consistent with the Temperature Guidance, and in situations where the end temperature is 25.0°C or more, but does not completely avoid adverse effects.

Provision (D) limits potential migration blockage conditions to less than 25% of the cross-sectional area of 100% of the 7Q10 low flow of the waterbody, where the ambient temperature is less than 21.0° C. In these situations, fish are likely to eventually find their way past such conditions, so any impairment of migration is likely to be temporary and unlikely to affect survival.

CM 2 offers the opportunity to obtain the information needed to validate that the thermal plume provisions in the Oregon rule protect anadromous fish by validating the thermal plume modeling associated with thermal plume provisions, and by assessing the effectiveness of the provisions in minimizing adverse effects to salmon and steelhead from thermal plumes.[10]

In its BE, EPA determined that the temperature thermal plume limitations provision use may affect, and is likely to adversely affect, the subject threatened and endangered species. NOAA Fisheries concurs with EPA's determination of effect due to the likelihood of thermal shock,

---

[10] ODEQ is likely to cooperate in this effort (February 5, 2004, email from Mark Charles, ODEQ, to Jeffrey Lockwood, NOAA Fisheries).

which could lead to localized, short-term adverse effects including delayed migration, sublethal physiological effects, increased predation susceptibility, and decreased survival, in adult and juvenile salmon and steelhead (all ESUs).

2.1.5.2 Effects on Critical Habitat

NOAA Fisheries designates critical habitat based on physical and biological features that are essential to the listed species. Essential features of designated critical habitat include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water velocity, space and safe passage. Effects to designated critical habitat from these categories would be similar to the effects to listed species described above in section 2.1.5.1.

2.1.5.3 Cumulative Effects

Cumulative effects are defined in 50 CFR 402.02 as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." NOAA Fisheries is not aware of any specific future non-federal activities within the action area that would cause greater effects to listed species than presently occurs. The action area includes significant tracts of private and state lands. Land use on these non-federal lands include rural development, agricultural, and commercial forestry. Chemical fertilizers or pesticides are used on many of these lands, but no specific information is available regarding their use. NOAA Fisheries generally does not consider existing rules governing timber harvests, agricultural practices, and rural development on non-federal lands within Oregon to be sufficiently protective of watershed, riparian, and stream habitat functions to support the survival and recovery of listed species. Therefore, habitat functions for listed salmon and steelhead may be at risk as a result of future activities on some non-federal lands within the state.

Non-Federal activities within the action area are expected to increase due to a projected 34% increase in human population by the year 2024 in Oregon (ODAS 1999). Thus, NOAA Fisheries assumes that future private and state actions will continue within the action area, increasing as population density rises.

2.1.6 Integration and Synthesis of Effects

In the fourth step of its effects analysis, NOAA Fisheries determines whether the proposed action, in light of the above factors, is likely to appreciably reduce the likelihood of the species' survival and recovery in the wild or lead to the destruction or adverse modification of critical habitat. NOAA Fisheries uses the consultation regulations to determine whether actions would further degrade the environmental baseline at a spatial scale relevant to the listed ESU.

Implementation and attainment of water quality standards are key to improving Oregon's water quality. NOAA Fisheries participated in the development of EPA's Temperature Guidance and worked closely with EPA and ODEQ in the development of Oregon's revised rules, to ensure that the criteria, beneficial uses, and narrative provisions meet the biological requirements of the 14 ESUs covered by this consultation. Nevertheless, some adverse effects may occur from approval and subsequent implementation of the subject water quality standards.

Effects of EPA's approval of Oregon's revised water quality standards for temperature, IGDO, and antidegradation implementation include:

1) For all ESUs—localized reduction in growth and survival of some listed salmon and steelhead embryos and alevins due to an IGDO criterion that may not, at all times, provide optimal levels of IGDO;
2) For SONC coho, OC coho, and LCR, MCR and SR steelhead—during the brief period of maximum summer temperatures, possible localized elevation of disease risk for adult and juvenile salmon and steelhead, reduced viability of gametes in some holding adults, and reduced growth of some juvenile salmon and steelhead due to possible under-designation of the 16°C beneficial use, and possible over-designation of the 18°C beneficial use;
3) For UWR and SR spring/summer chinook, and for UWR, MCR, and SR steelhead—localized elevation of disease risk for some adults and juveniles, and reduced viability of gametes in some holding adults due to possible over-designation of the 20°C beneficial use;
4) For all ESUs—in waters that are water quality limited for temperature, localized elevation of disease risk for some adult and juvenile salmon and steelhead, and reduced growth of some juvenile salmon and steelhead, due to the allowance for human use; and
5) For all ESUs—in a portion of temperature mixing zones, possible thermal shock, leading to short-term adverse effects including delayed migration, sublethal physiological effects, and increased predation susceptibility in some adult and juvenile salmon and steelhead.

The above effects will be localized and mostly limited to the period of maximum water temperatures during the warmest part of the summer. Also, EPA has included measures to ensure that the information needed to correct possible unavoidable errors in beneficial use designations will be developed, and that the effectiveness of the thermal plume provisions is validated. UCR spring chinook, UCR steelhead, and SR sockeye will not be affected by approval of the 12°C criterion, the 16°C criterion, the 18°C criterion, or associated beneficial uses, because their spawning and rearing habitat is located outside of the action area. Based on these factors, NOAA Fisheries has determined that any adverse effects from EPA's approval of the Oregon revised rules are unlikely to be of a magnitude, duration or extent that would reduce the long-term survival of the listed ESUs.

2.1.7 Conclusion

After reviewing the best available scientific and commercial information available regarding the current status of the 14 listed ESUs discussed in this Opinion, the baseline for the action area, the effects of the proposed action, and cumulative effects, NOAA Fisheries concludes that EPA's proposed approval of revised Oregon water quality standards for temperature, intergravel dissolved oxygen, and antidegradation implementation methods is not likely to jeopardize the continued existence of Upper Columbia River spring, Snake River spring/summer and fall, Upper Willamette River, and Lower Columbia River chinook salmon; Oregon Coast and Southern Oregon/Northern California coasts coho salmon; Columbia River chum salmon; Snake River, Middle and Lower Columbia River, Upper Columbia River, and Upper Willamette River steelhead; or Snake River sockeye salmon.

NOAA Fisheries concludes that the proposed action is not likely to destroy or adversely modify designated critical habitat of Snake River spring/summer chinook salmon, Snake River fall chinook salmon, Snake River steelhead, or Southern Oregon/Northern California coasts coho salmon. Our conclusion is based on the analysis of effects on habitat pathways described in section 2.1.5.

2.1.8 Reinitiation of Consultation

To the extent EPA retains discretionary involvement or control over this action as described in 50 CFR 402.16, EPA must reinitiate consultation if: (1) The action is modified in a way that causes an effect on the listed species that was not previously considered in this Opinion; (2) new information or project monitoring reveals effects of the action that may affect the listed species in a way not previously considered; (3) a new species is listed or critical habitat is designated that may be affected by the action; or (4) if the amount or extent of incidental take is exceeded (50 CFR 402.16).

Using the process described in the EPA conservation measure pertaining to the 2-year review of the revised ODEQ water quality standards, NOAA Fisheries will assess:

1) Where the water quality standards allow discretion, whether the resultant effects on listed species and critical habitat are consistent with those described in this Opinion; and

2) Whether EPA has provided the information described in its conservation measures in a timely manner.

If ODEQ's exercise of its discretion has resulted in effects on listed species and critical habitat that are not consistent with those described in this Opinion, or if EPA does not provide the information described in the conservation measures by the dates specified in the measures, NOAA Fisheries may consider either of those circumstances to be a modification of the action that causes an effect on listed species not previously considered, potentially resulting in the need to reinitiate consultation.

Any subsequent "may affect" CWA approval by EPA of a modified temperature standard adopted by the state of Oregon would constitute a new Federal action requiring ESA section 7 consultation.

2.2 Incidental Take Statement

The ESA at section 9 [16 USC 1538] prohibits take of endangered species. The prohibition of take is extended to threatened anadromous salmonid fishes by section 4(d) rule [50 CFR 223.203]. Take is defined by the statute as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." [16 USC 1532(19)] Harm is defined by regulation as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavior patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering." [50 CFR 222.102] Harass is defined as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering." [50 CFR 17.3] Incidental take is defined as "takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant." [50 CFR 402.02] The ESA at section 7(o)(2) removes the prohibition from any incidental taking that is in compliance with the terms and conditions specified in a section 7(b)(4) incidental take statement [16 USC 1536].

2.2.1 Amount or Extent of Take

Incidental take of listed salmon and steelhead due to effects of temperature or IGDO is reasonably certain to occur in Oregon even if the proposed standards are attained. Take may be due to approval of any of the following: (1) Localized reduction in growth and survival of some listed salmon and steelhead embryos and alevins due to the IGDO criterion; (2) water temperature criteria and beneficial use designations that in certain times and places would be likely to harm some listed salmon and steelhead through impairment of certain essential behavioral patterns; (3) a human use allowance that will allow additions of heat to water-quality limited waters prior to a TMDL being completed; and (4) water quality standards that could lead to sublethal physiological effects and delay or blockage of migration within a portion of temperature mixing zones. Consequently, EPA requested incidental take authorization.

Because of the nature and scope of the proposed action, the best scientific and commercial data available are not sufficient to enable NOAA Fisheries to estimate a specific amount of incidental take associated with the proposed action. NOAA Fisheries has determined, however, that the extent of take that is reasonably certain to occur is below the level that would be likely to jeopardize the listed species that are affected by this action, as explained in the *Analysis of Effects* and *Integration and Synthesis of Effects* sections of this Opinion.

NOAA Fisheries authorizes incidental take by EPA of listed species of salmon and steelhead due to: (1) Effects of EPA's approval of Oregon's revised water quality standards for IGDO and water temperature in waters that are in compliance with the these standards; and (2) approval of thermal plume provisions for discharges that meet applicable temperature standards in water quality limited waters. With respect to EPA's approval of ODEQ's thermal plume provisions for point source discharges, incidental take related to these provisions is authorized only for effects to listed species that are consistent with and no greater than those described in the thermal plume discussion of section 2.1.5.1.6 of the *Analysis of Effects* in this Opinion. Incidental take that is caused by other water quality variables besides temperature or IGDO (*e.g.*, turbidity, toxic compounds) is beyond the scope of this incidental take statement.

There may be future ESA section 7 consultations on particular "may affect" EPA approvals of actions implementing the water quality standards covered by this Opinion. Incidental take may be authorized in these subsequent consultations. Where there is no Federal nexus for consultation, entities may wish to seek incidental take coverage for activities (such as execution of non-point source management plans) through other ESA mechanisms, including section 4(d) limits or section 10 incidental take permits.

2.2.2 Reasonable and Prudent Measures

NOAA Fisheries believes that the following reasonable and prudent measure is necessary and appropriate to minimize incidental take of listed salmon and steelhead:

1. Minimize the likelihood of incidental take resulting from EPA's approval of certain beneficial use designations and thermal plume provisions zones by monitoring to confirm use designations and effects of temperature mixing zones.

2.2.3 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the EPA must comply with the following terms and conditions, which implement the reasonable and prudent measure described above. These terms and conditions are non-discretionary.

1. The EPA shall implement the following term and condition to monitor water temperatures and evaluate use designations. EPA will set up a team consisting of representatives from EPA, NOAA Fisheries, USFWS, and ODEQ with the purpose of designing a temperature monitoring plan to validate assumptions with regard to spatial and seasonal temperature patterns associated with application of the numeric criteria and to identify waters that are colder than the criteria in selected basins with distinct populations of ESA-listed coho, steelhead, and bull trout. The team will leverage to the greatest extent possible existing state and local monitoring programs to meet the objectives of the monitoring plan. If needed, the team will seek additional funding and develop partnerships to collect temperature data that implements the plan and to the greatest extent possible simultaneously meets other monitoring objectives to maximize the usefulness of the data. The team will be assembled by December 30, 2004. The team will design a monitoring plan by March 30, 2005, with the goal of initial data collection during the summer of 2005 and complete data collection during the summer of 2006. This term and condition is the same as CM 1 described in section 1.2.3 above.

2. The EPA shall implement the following term and condition to validate and monitor thermal plume provisions to obtain information needed to validate that the thermal plume provisions in the Oregon rule protect anadromous fish. There are two parts to this measure:

   a. To validate the thermal plume modeling associated with thermal plume provisions.
   b. To assess the effectiveness of the provision in the Oregon Rules related to the protection of salmonids from impacts of thermal plumes and heat loads.

   During Part A of this conservation measure, EPA will work with ODEQ and the Services to identify three representative NPDES permits to be issued by ODEQ containing thermal plume provisions, for oversight consistent with the coordination procedures of the National Memorandum of Understanding (MOA). The three permits will be selected to represent different conditions (*e.g.*, large river system, small river system). The EPA, ODEQ, NOAA Fisheries, and USFWS collaboration on these permits will ensure that adequate thermal plume provisions are incorporated in the permits, and that the permits contain monitoring requirements to validate the modeling.

   During Part B of this conservation measure, EPA will work with the Services and ODEQ to design a monitoring study to validate that point source thermal discharges in accordance with the thermal plume provision in Oregon's water quality standards avoid or minimize adverse effects to salmon and steelhead. Study design work will begin within approximately 60 days of EPA's identification of the each of the three permits in Part A and will be completed within 120 days. Upon completion of the monitoring study design, EPA will seek funding from all possible sources, including private industry associations to support the monitoring study. EPA will report to NOAA Fisheries and the USFWS on the status of funding efforts within 180 days of commencing the search for funding. Should EPA secure funding, monitoring work shall begin during the next summer following funding, and EPA will provide the study results to the Services within 6 months after the monitoring is completed. This term and condition is the same as CM 2 described in section 1.2.3 above.

3. EPA shall implement the following term and condition to monitor implementation of Oregon's antidegradation implementation methods. Within two years of the date of EPA's approval of the Oregon rules, EPA will participate with ODEQ, NOAA Fisheries, the USFWS, and interested tribes in a review of the Oregon Division 41 Rules, including consideration of: (1) Implementation of the antidegradation provisions, the natural conditions provisions, the thermal plume provisions, heat load limits, and variances; (2) identification of cold water refugia under the migration corridor criterion; (3) progress on effluent trading pilot programs; and (4) application of the requirement to ensure no adverse effects to threatened and endangered species as part of ODEQ's antidegradation

implementation methods. This term and condition is the same as CM 3 described in section 1.2.3, above.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

3.1 Background

Pursuant to the MSA:

- NOAA Fisheries must provide conservation recommendations for any Federal or state action that would adversely affect EFH (§305(b)(4)(A)).
- Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.10). "Adverse effect" means any impact which reduces quality and/or quantity of EFH, and may include direct (*e.g.*, contamination or physical disruption), indirect (*e.g.*, loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). EFH consultation with NOAA Fisheries is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects on EFH.

3.2 Identification of EFH

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Federally-managed Pacific salmon: Chinook (*O. tshawytscha*); coho (*O.*

kisutch); and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other waterbodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC 1999), and longstanding, naturally-impassable barriers (*i.e.*, natural waterfalls in existence for several hundred years). EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.110). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (*e.g.*, contamination or physical disruption), indirect (*e.g.*, loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Detailed descriptions and identifications of EFH are contained in the fishery management plans for groundfish (PFMC 1999), coastal pelagic species (PFMC 1999a), and Pacific salmon (PFMC 1999b). Casillas *et al.* (1998) provides additional detail on the groundfish EFH habitat complexes.

3.3 Proposed Action

The proposed action is detailed above in section 1.2 and section 2.1.5 of this document. For this consultation, NOAA Fisheries defines the action area as all basins in Oregon with anadromous fish use (Figure 1) or designated critical habitat, including the Columbia River from the mouth to the Washington-Oregon border, and the Snake River from river mile 169 to river mile 247.5. This area has been designated as EFH for various life stages of groundfish species and chinook and coho salmon (Table 3).

3.4 Effects of Proposed Action

Implementation and attainment of water quality standards are key to improving Oregon's water quality. NOAA Fisheries participated in the development of EPA's Temperature Guidance and worked closely with EPA and ODEQ in the development of Oregon's revised rules, to ensure that the criteria, beneficial uses and narrative provisions meet the biological requirements of Pacific salmon and steelhead. As Oregon completes TMDLs designed to meet the revised standards, issues or reissues permits in conjunction with those TMDLs, and incorporates nonpoint source controls adequate to meet water quality standards, the condition of impaired waters is likely to improve. Nevertheless, some short-term, localized adverse effects may occur from approval and subsequent implementation of the standards.

The proposed action will adversely affect habitat for chinook and coho salmon and groundfish species due to: (1) Localized reduction in growth and survival of some chinook and coho embryos and alevins due to approval of an IGDO criterion that may not, at all times, provide optimal levels of IGDO (biological opinion, p. 31-33); (2) possible localized, short-term adverse effects to including elevation of disease risk in some coho and chinook, reduced growth of some juvenile coho and chinook, and reduced viability of gametes in some holding chinook and coho adults due to approval of certain numeric criteria and certain beneficial uses (biological opinion, p. 34-54); and (3) in a portion of temperature mixing zones, possible localized, short-term adverse effects including delayed migration, sublethal physiological effects, and increased predation susceptibility in some adult and juvenile chinook and coho, and potentially in some groundfish species (see Appendix A), due to approval of thermal plume provisions (biological opinion, p. 52-54).

3.5 Conclusion

The proposed action is likely to lead to improvements in water quality for temperature and IGDO at the river basin scale, but in some localized places and times the action will adversely affect EFH for chinook and coho salmon and groundfish species.

3.6 EFH Conservation Recommendations

Pursuant to section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations for any Federal or state agency action that would adversely affect EFH. The conservation measures proposed for the project (Introduction, section 1.2.3), and all of the *reasonable and prudent measures* and *terms and conditions* contained in sections 2.2.2 and 2.2.3 of the biological opinion are applicable. Therefore, NOAA Fisheries incorporates each of those measures here as EFH conservation recommendations.

3.7 Statutory Response Requirement

Please note that the MSA (section 305(b)) and 50 CFR 600.920G) requires the Federal agency to provide a written response to NOAA Fisheries after receiving EFH conservation recommendations within 30 days of its receipt of this letter. This response must include a description of measures proposed by the agency to avoid, minimize, mitigate or offset the adverse effects of the activity on EFH. If the response is inconsistent with a conservation recommendation from NOAA Fisheries, the agency must explain its reasons for not following the recommendation.

3.8 Supplemental Consultation

The EPA must reinitiate EFH consultation with NOAA Fisheries if the action is substantially revised or new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR 600.920).

Table 3. Pacific salmon and groundfish species with designated EFH in the estuarine composite in the state of Oregon. Designated EFH for chinook and coho salmon includes the historical freshwater extent of the species.

Groundfish Species	
Leopard Shark (southern OR only)	*Triakis semifasciata*
Soupfin Shark	*Galeorhinus zyopterus*
Spiny Dogfish	*Squalus acanthias*
California Skate	*Raja inornata*
Spotted Ratfish	*Hydrolagus colliei*
Lingcod	*Ophiodon elongatus*
Cabezon	*Scorpaenichthys marmoratus*
Kelp Greenling	*Hexagrammos decagrammus*
Pacific Cod	*Gadus macrocephalus*
Pacific Whiting (Hake)	*Merluccius productus*
Black Rockfish	*Sebastes maliger*
Bocaccio	*Sebastes paucispinis*
Brown Rockfish	*Sebastes auriculatus*
Copper Rockfish	*Sebastes caurinus*
Quillback Rockfish	*Sebastes maliger*
English Sole	*Pleuronectes vetulus*
Pacific Sanddab	*Citharichthys sordidus*
Rex Sole	*Glyptocephalus zachirus*
Rock Sole	*Lepidopsetta bilineata*
Starry Flounder	*Platichthys stellatus*
Pacific Salmon Species	
Chinook Salmon	*Oncorhyncus tshawytcha*
Coho Salmon	*Oncorhyncus kisutch*

4. LITERATURE CITED

Section 7(a)(2) of the ESA requires biological opinions to be based on the best scientific and commercial data available. This section identifies the information sources for the data used in developing this Opinion.

Botkin, D., K. Cummins, T. Dunne, H. Regier, M. Sobel, and L. Talt. 1995. Status and future of salmon of western Oregon and northern California: Findings and options. Report #8. The Center for the Study of the Environment, Santa Barbara, California. http://www.naturestudy.org/services/publica.htm

Brannon, E.L. 1965. The influence of physical factors on the development and weight of sockeye salmon embryos and alevins. Progress Report No. 12. International Pacific Salmon Fisheries Commission, New Westminster, B.C., Canada.

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. Leirheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-27. 281 p.

Carson, K.A. 1985. A model of salmonid egg respiration. M.S. thesis. Agricultural and Chemical Engineering Department, Colorado State University, Fort Collins. 108 p.

Chapman, D.W. and K.P. McLeod. 1987. Development of criteria for fine sediment in the Northern Rockies ecoregion. Final Report. EPA contract no. 68-01-6986.

Chapman, D., C. Pevan, T. Hillman, A. Giorgi, and F. Utter. 1994. Status of summer steelhead in the mid-Columbia River. Don Chapman Consultants, Inc., ise, Idaho.

Coble, D.W. 1961. Influence of water exchange and dissolved oxygen on survival of steelhead trout embryos. Trans. Am. Fish. Soc. 90(4):469-474.

Cooney, T.D. 2002. UCR steelhead and spring chinook salmon quantitative analysis report. Part 1: Run reconstructions and preliminary assessment of extinction risk. National Marine Fisheries Service, Hydro Program, Technical Review Draft, Portland, Oregon.

Coutant, C.C. 1973. Effects of thermal shock on vulnerability of juvenile salmonids to predation. J. Fish. Res. Bd. Canada 30:965-973.

Dewberry, T.C. 2003. Development and application of anchor habitat approaches to salmon conservation: A synthesis of data and observation from the Siuslaw watershed, coastal Oregon. Unpublished draft report. Portland, Oregon. 16 p. July.

Dunham, J., J. Lockwood, and C. Mebane. 2001. Salmonid Distribution and Temperature. Issue Paper 2. Prepared as part of EPA Region 10 Temperature Water Quality Criteria Guidance Development Project. EPA-910-D-01-002. U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 22 p.

Ebel, W.J., E.M. Dawley, and B.H. Monk. 1971. Thermal tolerance of juvenile Pacific salmon and steelhead trout in relation to supersaturation of nitrogen gas. United States Fisheries Bulletin 69(4):833-843.

Ecotrust, Oregon Trout, and The Wild Salmon Center. 2000. A Salmon Anchor Habitat Strategy for the Tillamook and Clatsop State Forests. Updated Version, March 2001. Portland, Oregon. 29 p. plus appendices.

EPA (Environmental Protection Agency). 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards. U.S. Environmental Protection Agency, Region 10, Office of Water, Seattle, WA. 49 p. www.epa.gov/r10earth/temperature.htm

Evermann, B.W. 1895. A preliminary report upon salmon investigations in Idaho in 1894. U.S. Fish Commission Bulletin15:253-284.

FEMAT (Forest Ecosystem Management Assessment Team). 1993. Forest ecosystem management; and ecological, economic, and social assessment. Report of the Forest Ecosystem Management Assessment Team. U.S. Government Printing Office 1993-793-071. U.S. Government Printing Office for the U.S.D.A. Forest Service; U.S. Department of Interior, Fish and Wildlife Service, Bureau of Land Management, and National Park Service; U.S. Department of Commerce, National Oceanic and Atmospheric Administration and National Marine Fisheries Service; and the U.S. Environmental Protection Agency.

Fish Passage Center. 2003. Fish Passage Center annual report–2002. Fish Passage Center, Columbia River Basin Fish and Wildlife Authority, Portland, OR.

Fulton, L.A. 1968. Spawning areas and abundance of Chinook salmon, *Oncorhynchus tshawytscha*, in the Columbia River basin–past and present. U.S. Fish and Wildlife Service, Special Scientific Report, Fisheries 571:26.

Fulton, L.A. 1970. Spawning areas and abundance of steelhead trout and coho, sockeye, and chum salmon in the Columbia River basin–past and present. U.S. Fish and Wildlife Service, Special Scientific Report, Fisheries 618.

Hassler, T.J. 1987. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest) – coho salmon. U.S. Fish Wildl. Serv. Biol.

Rep. 82(11.70). U.S. Army Corps of Engineers, TR EL-82-4. 19 p. http://www.nwrc.usgs.gov/wdb/pub/0132.pdf

Henjum, M.G. and seven others. 1994. Interim protection for late-successional forests, fisheries and watersheds. National Forests east of the Cascade crest, Oregon and Washington. A report to the United States Congress and the President. The Wildlife Society, Bethesda, MD. www.wildlife.org/publications/index.cfm?tname=pubs&pubid=pub05

Hollender, B.A. 1981. Embryo Survival, Substrate Composition and Dissolved Oxygen in Redds of Wild Brook Trout. University of Wisconsin, Stevens Point. 87 p.

Howell, P., K. Jones, D. Scarnecchia, L. LaVoy, W. Knedra, and D. Orrmann. 1985. Stock assessment of Columbia River anadromous salmonids, 2 volumes. Final Report to nneville Power Administration, Portland, Oregon (Project 83-335).

Jackson, P.L. 1993. Climate. P. 48-57 in: Jackson, P.L and A. J. Kimerling (eds.). Atlas of the Pacific Northwest. Oregon State University Press, Corvallis, Oregon.

Johnson, O.W., W.S. Grant, R.G. Cope, K. Neely, F.W. Waknitz, and R.S. Waples. 1997. Status review of chum salmon from Washington, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-32. 280 p.

Lee, D.C., JR. Sedell, B.E. Reiman, R.F. Thurow, J.E. Williams. 1997. Broadscale assessment of aquatic species and habitats. P. 1058-1496 in: T.M. Quigley and S.J. Arbelbide, eds. An Assessment of Ecosystem Components in the Interior Columbia Basin and portions of the Klamath and Great Basins. U.S. Forest Service General Technical Report PNW-GTR-405. Portland, OR. http://www.icbemp.gov/science/scipubs.shtml

Maret, T.R., T.A. Burton, G.W. Harvey, and W.H. Clark. 1993. Field testing of new monitoring protocols to assess brown trout spawning habitat in an Idaho stream. N. Am. J. Fish. Man. 13:567-580.

Marr, J.C. 1943. Age, length, and weight studies of three species of Columbia River salmon (*Oncorhynchus keta, O. gorbuscha and O. kisutch*). Stanford Ichthyological Bulletin 2:157-197.

Mason, J.C. 1969. Hypoxial stress prior to emergence and competition among coho salmon fry. J. Fish. Res. Bd. Canada 26:63-91.

Materna, E. 2001. Issue paper 4: temperature interaction. Prepared as part of EPA Region 10 Temperature Water Quality Criteria Guidance Development Project. EPA-910–D-01-004. U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 33 p.

Matthews, G. M., and R. S. Waples. 1991. Status review for Snake River spring and summer chinook salmon. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-200. 75 p.

Mattson, C.R. 1948. Spawning ground studies of Willamette River spring Chinook salmon. Fish Commission of Oregon Research Briefs 1(2):21-32.

McClure, M., B. Sanderson, E. Holmes, C. Jordan, P. Kareiva, and P. Levin. 2 000. Revised Appendix B of standardized quantitative analysis of the risks faced by salmonids in the Columbia River basin. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington.

McCullough, D.A. 1999. A review and synthesis of effects of alterations to the water temperature regime on freshwater life stages of salmonids, with special reference to chinook salmon. Prepared for the U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 279 p.

McCullough, D.A., S. Spalding, D. Sturdevant, and M. Hicks. 2001. Issue paper 5: Summary of technical literature examining the physiological effects of temperature on salmonids. Prepared as part of EPA Region 10 Temperature Water Quality Criteria Guidance Development Project. EPA-910-D-01-005. U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 114 p.

McIntosh, B.A., J.R. Sedell, J.E. Smith, R.C. Wissmar, S.E. Clarke, G.H. Reeves, and L.A. Brown. 1994. Management history of eastside ecosystems: Changes in fish habitat over 50 years, 1935 to 1992. USDA Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-321. February.

McElhany, P., M. Ruckleshaus, M. J. Ford, T. Wainwright, and E. Bjorkstedt. 2000. Viable Salmon Populations and the Recovery of Evolutionarily Significant Units. U.S. Dept. Commer., NOAA Technical Memorandum NMFS-NWFSC-42. 156 p.

McKernan, D.L., and C.R. Mattson. 1950. Observations on pulp and paper effluents and the probable effects of this pollutant on the fisheries resources of the Willamette River in Oregon. Fish Commission of Oregon, Fish Commission Research Briefs 3(1):14-21.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. NMFS-NWFSC-35. U.S. Dept. Commer., NOAA Technical Memorandum. 443 p.

National Research Council. 1996. Upstream–Salmon and Society in the Pacific Northwest. National Academy Press, Washington, D.C.

Nickelson, T.E., J.D. Rodgers, S.L. Johnson, and M.F. Solazzi. 1992. Seasonal changes in habitat use by juvenile coho salmon (*Oncorhynchus kisutch*) in Oregon coastal streams. Canadian J. Fish. Aquat. Sci. 49:783-789.

NOAA Fisheries (NOAA's National Marine Fisheries Service). 1995. Proposed recovery plan for Snake River salmon. Protected Resources Division, Portland, Oregon.

NOAA Fisheries (NOAA's National Marine Fisheries Service). 1999a.. Biological and conference opinion. Approval of Oregon water quality standards for dissolved oxygen, temperature, and pH. National Marine Fisheries Service, Northwest Region, Seattle, WA.

NOAA Fisheries (NOAA's National Marine Fisheries Service). 1999b. Biological opinion on artificial propagation in the Columbia River basin–Incidental take of listed salmon and steelhead from Federal and non-Federal hatchery programs that collect, rear, and release unlisted fish species. National Marine Fisheries Service, Northwest Region, Seattle, WA.

NOAA Fisheries (NOAA's National Marine Fisheries Service). 1999. The habitat approach. Implementation of section 7 of the Endangered Species Act for actions affecting the habitat of Pacific anadromous salmonids. Northwest Region, Habitat Conservation and Protected Resources Divisions. August 26.

NOAA Fisheries (NOAA's National Marine Fisheries Service. 2000. Biological Opinion. Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin. National Marine Fisheries Service, Northwest Region, Seattle, WA.

Oregon Coastal Salmon Restoration Initiative. 1997. State of Oregon, Salem, Oregon. March 10.

Oregon Department of Administrative Services. 1999. Oregon Economic and Revenue Forecast. Vol. XIX. No. 2. Office of Economic Analysis, Salem.

ODEQ (Oregon Department of Environmental Quality). 1995. Dissolved Oxygen. Final Issue Paper. 1992-1994 Water quality standards review. Standards and Assessment Section, Portland, Oregon.

ODEQ (Oregon Department of Environmental Quality). 2003. Oregon Department of Environmental Quality Laboratory Technical Services electronic database, Portland, Oregon. Accessed September 24 and October 24, 2003.

ODFW (Oregon Department of Fish and Wildlife). 1998a. Briefing paper–Lower Columbia River chinook ESU. ODFW, Portland. October 13.

ODFW (Oregon Department of Fish and Wildlife). 2002. 1:24K Fish Habitat Distribution Development Project Procedures Manual. Salem, Oregon. http://oregonstate.edu/dept/nrimp/24k/

ODFW (Oregon Department of Fish and Wildlife). 2003b. Coastal salmonid inventory project: coho abundance–stratified random sampling estimates for coastal river basins 1990-2002. http://oregonstate.edu/Dept/ODFW/spawn/coho.htm

Phelps, S.R., L.L. LeClair, S. Young, and H.L. Blankenship. 1994. Genetic diversity patterns of chum salmon in the Pacific Northwest. Canadian J. Fish. Aquat. Sci. 51 (Suppl. 1):65-83.

Phillips, R.W. and H.J. Campbell. 1962. The embryonic survival of coho salmon and steelhead trout as influenced by some environmental conditions in gravel beds. P. 60-73 in: 14th Annual Report. Pacific Marine Fisheries Commission, Portland, OR. 108 p.

Poole, G.C., and C. Berman. 2001. An ecological perspective on in-stream temperature: natural heat dynamics and mechanisms of human-caused thermal degradation. Environmental Management 27(6):787-802.

Poole, G., J. Risley, and M. Hicks. 2001. Issue paper 3: Spatial and temporal patterns of stream temperature (revised). EPA-910-D-01-003. U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 31 p.

Rhodes, J.J., D.A. McCullough, and F.A. Espinosa, Jr. 1994. A coarse screening process for potential application in ESA consultations. Columbia River Intertribal Fish Commission. Prepared under NMFS/BIA Inter-Agency Agreement 40ABNF3. December. http://www.critfc.org/tech/94-4report.htmL

Reisenbichler, R.R., J.D. McIntyre, M.F. Solazzi, and S.W. Landino. 1992. Genetic variation in steelhead of Oregon and northern California. Trans. Am. Fish. Soc. 121:158-169.

Rich, W.H. 1942. The salmon runs of the Columbia River in 1938. Fisheries Bulletin 50:103-147.

Risser, P.G. 2000. Oregon State of the Environment Report. Oregon Progress Board.

Rombaugh, P.J. 1986. Mathematical model for predicting the DO requirements of steelhead (*Salmo gairdneri*) embryos and alevins in hatchery incubators. Aquaculture 59:119-137.

Salo, E.O. 1991. Life history of chum salmon, *Oncorhynchus keta*. P. 231-309 in: C. Groot and L. Margolis, eds. Pacific salmon life histories. University of British Columbia Press, Vancouver, B.C.

Sauter, S.T., J. McMillan, and J. Dunham. 2001. Issue paper 1: Salmonid behavior and water temperature. Prepared as part of EPA Region 10 Temperature Water Quality Criteria Guidance Development Project. EPA-910-01-001. U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 36 p.

Schreck, C.B., H.W. Li, R.C. Jhort, and C.S. Sharpe. 1986. Stock identification of Columbia River chinook salmon and steelhead trout. Final report to Bonneville Power Administration, Portland, Oregon (Project 83-451).

Skaugsett, A.E. 1980. Fine organic debris and dissolved oxygen in streambed gravels in the Oregon Coast Range. M.S. thesis. Forest Engineering Department, Oregon State Univ., Corvallis. 77 p.

Sowden, T.K. and G. Power. 1985. Prediction of rainbow trout embryo survival in relation to groundwater seepage and particle size of spawning substrates. Trans. Am. Fish. Soc. 114:804-812.

Spence, B.C., G.A. Lomnicky, R.M. Hughes, R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, OR.

Tang, J., M.D. Bryant, and E.L. Brannon. 1987. Effect of temperature extremes on the mortality and development rates of coho salmon embryos and alevins. Prog. Fish-Cult. 49(3):167-174.

Turnpenny, A.W.H.and R. Williams. 1980. Effects of sedimentation on the gravels of an industrial river system. J. Fish. Biol. 17:681-693.

USFWS (U.S. Fish and Wildlife Service). 1999. Oregon water quality standards ESA consultation. U.S. Department of the Interior, U.S. Fish and Wildlife Service, Oregon State Office, Portland, OR. July 1, 1999.

Vaux, W.G. 1962. Interchange of stream and intragravel water in a salmon spawning riffle. Special Scientific Report – Fisheries No. 405. U.S. Dept. of the Interior, Fish and Wildlife Service. 11 p.

Waples, R.S. 1999. Dispelling some myths about hatcheries. Fisheries 24(2)12-21.

Waples, R.S., R.P. Jones, Jr., B.R. Beckman, and G.A. Swan. 1991a. Status review for Snake River fall chinook salmon. U.S. Department of Commerce, NOAA Tech. Memo. NMFS F/NWC-201. 73 p.

Waples, R. S., O.W. Johnson, and R.P. Jones, Jr. 1991b. Status review for Snake River sockeye salmon. U.S. Department of Commerce, NOAA Technical Memorandum NMFS

F/NWC-195. Prepared by the National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, WA. 14 p.

WDF (Washington Department of Fisheries), WDW (Washington Department of Wildlife), and WWTIT (Western Washington Treaty Indian Tribes). 1993. Washington state salmon and steelhead stock inventory (SASSI), 1992. WDF, WDW, and WWTIT, Olympia.

WDFW (Washington Department of Fish and Wildlife). 2000. Chum salmon: Columbia River chum salmon. Washington Department of Fish and Wildlife, Olympia, WA. Available online at: <http://www.wa.gov/wdfw/fish/chum/chum-7.htm>

Wedemeyer, G. 1973. Some physiological aspects of sublethal heat stress in the juvenile steelhead trout (*Salmo gairdneri*) and coho salmon *(Oncorhynchus kisutch*). J. Fish. Res. Bd. Canada 30:831-834.

Weitkamp, L.A., T.C. Wainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC-24. National Marine Fisheries Service, Northwest Fisheries Science Center, Coastal Zone and Estuarine Studies Division, Seattle, WA.

Wissmar, R.C., J.E. Smith, B.A. McIntosh, H.W. Li, G.H. Reeves, and J.R. Sedell. 1994. Ecological health of river basins in forested regions of eastern Washington and Oregon. Gen. Tech. Rep. PNW-GTR-326. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, Oregon. 65 p. http://www.fs.fed.us/pnw/publications/popularpubs.shtml

Water Temperature Criteria Technical Workgroup. 2001. Technical synthesis: scientific issues relating to temperature criteria for salmon, trout, and char native to the Pacific Northwest. A summary report submitted to the Policy Workgroup of the USEPA Region 10 Water Temperature Criteria Guidance project. EPA910-R-01-007. U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 21 p.

Appendix A

Temperature Preferences for Groundfish with Designated Essential Fish Habitat

Appendix A. Temperature Preferences for Groundfish with Designated Essential Fish Habitat

GROUNDFISH		ADULT	SPAWN	JUVENILE	LARVAL	EGGS
Black Rockfish	*Sebastes melanops*	8-18 ºC		8-18ºC		NA
Bocaccio	*Sebastes paucispinis*	6-15.5 ºC			Warm >12 ºC (preferred)	NA
Brown Rockfish	*Sebastes auriculatus*	10-17ºC, 7-13 ºC tolerate up to 22ºC	10-17ºC, tolerate up to 22ºC	10-17ºC, tolerate up to 22ºC	9-17ºC	NA
Cabezon	*Scorpaenichthys marmoratus*	11-13 ºC	7-13 ºC(CA)			
California Skate	*Raja inornata*				NA	
Copper Rockfish	*Sebastes caurinus*	7 - 13 ºC			9 - 17.2 ºC(WA)	NA
English Sole	*Pleuronectes vetulus*	8-9 ºC (optimal), 10.2-11 ºC, 8-10.3 ºC	Not <7.8 (gonad dev inhibited)	18 ºC (upper threshold tolerance)	8 - 9 ºC (optimal)	4 - 12 ºC, 8-9 ºC (optimal)
Kelp Greenling	*Hexagrammos decagrammus*	9-13 ºC (WA)	9-13 ºC (WA)	9-13 ºC (WA)		9-13 ºC (WA)
Leopard Shark	*Triakis semifasciata*				NA	NA
Lingcod	*Ophiodon elongatus*	6.7 - 10, 5-15	15-May	15-May	15-May	15-May
Pacific Cod	*Gadus macrocephalus*	<10 ºC	0-10 ºC	<10 ºC	<10 ºC	3.5-4.9 ºC (optimal) 7-8 ºC, 3-6 ºC (hatching)
Pacific Sanddab	*Citharichthys sordidus*					4-12 ºC, 8-9 ºC (optimal)
Pacific Whiting (Hake)	*Merluccius productus*	9-15 ºC	9-15 ºC	9-15 ºC	9-15 ºC	9-15 ºC
Quillback Rockfish	*Sebastes maliger*					NA
Rex Sole	*Glyptocephalus zachirus*	7.2 ºC (gen)				
Rock Sole	*Lepidopsetta bilineata*	0 - 12.2 ºC, 7.2 - 10 ºC (optimal)			6 ºC (optimal)	0-15 ºC
Soupfin Shark	*Galeorhinus zyopterus*				NA	NA
Spiny Dogfish	*Squalus acanthias*	3.7-15.6 ºC, 6-11 ºC (preferred)	3.7-15.6 ºC, 6-11 ºC (preferred)	3.7-15.6 ºC, 6-11 ºC (preferred)	NA	NA
Spotted Ratfish	*Hydrolagus colliei*				NA	NA
Starry Flounder	*Platichthys stellatus*	0 - 12.5 ºC	0 - 12.5 ºC	0 - 12.5 ºC	0 - 12.5 ºC	0 - 12.5 ºC